

HUMPHREY PUMPS & COBDOGLA PUMPING STATION  
COBDOGLA, SA

SUBMISSION TO ENGINEERING HERITAGE AUSTRALIA  
for a  
NATIONAL ENGINEERING LANDMARK



November 08

Nomination prepared by Alison Miller

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## Introduction

The Humphrey pumps at Cobdogla Pumping Station are two of the few remaining pumps worldwide designed by Herbert Alfred Humphrey. The pump is driven by gas combustion which forces water in a U-shaped pipe to act like a piston, lifting the water to an elevated position. It is an elegant and simple design due to the elimination of all moving parts, with the exception of the spring-loaded valves.

The two pumps installed at Cobdogla in the early 1900s were used to irrigate the Cobdogla, Loveday and Nookamka areas. Water was lifted 34 feet (later reduced to 27 feet when the combustion chamber was raised during renovation) to a main channel which diverted water for irrigation.

The pumps no longer run as a pumping station due to the shortage of wood fuel (as the gas fuel was manufactured on site), but one is still in working condition and operates at times for the Cobdogla Irrigation Museum.

The Humphrey pumps at Cobdogla are nominated for a National Engineering Landmark because

- a) They were a significant and unique step in the progression of large pumping plants
- b) The two pumps installed at Cobdogla are the only two of their kind in the Southern Hemisphere
- c) One of the pumps is now the only working Humphrey pump in the world

## Nomination Form

The Administrator  
Engineering Heritage Australia  
Engineers Australia  
Engineering House  
11 National Circuit  
BARTON ACT 2600

**Name of work:** Humphrey Pumps and ancillary pumping station, Cobdogla, SA.

The above-mentioned work is nominated to be awarded a **National Engineering Landmark**.

**Location, including address and map grid reference if a fixed work:**

Just off Trussell Terrace, Cobdogla next to Cobdogla Swamp at AMG point 69291 – overland corner 446102.

**Owner (name & address):**

SA Water Corporation. SA Water House, Ground Floor, 77 Grenfell Street, Adelaide.

**The owner has been advised of this nomination and a letter of agreement has been obtained.**

**Access to site:**

Access is from Trussell Terrace, Cobdogla. There is no public access to the pumps, except on operating days of the Cobdogla Irrigation Museum. These dates can be obtained on the Museum webpage [http://www.nationaltrustsa.org.au/properties/bamera\\_cobdogla.htm](http://www.nationaltrustsa.org.au/properties/bamera_cobdogla.htm). Alternate access times can be arranged by the museum.

**Nominating Body:** Engineering Heritage Association, South Australian Branch.



Chair of Nominating Body

Date: 3<sup>rd</sup> November, 2008



Chair of Division Engineering Heritage Group

Date: 3<sup>rd</sup> November, 2008

# Location Map



## Heritage Assessment

### 1. BASIC DATA

**Item Name:** HUMPHREY PUMPS, COBDOGLA

**Other/Former Names:** Cobdogla Pumping Station

**Location (grid reference if possible):** Trussell Terrace, Cobdogla next to Cobdogla Swamp at AMG point 69291 – overland corner 446102.

**Address:** Just off Trussell Terrace, Cobdogla

**Postal:** Cobdogla Irrigation Museum, PO Box 302, Barmera SA 5345

**Suburb/Nearest Town:** Cobdogla

**State:** South Australia

**Local Govt. Area:** Berri Barmera Council

**Owner:** SA Water Corporation

**Current Use:** Operating in the Cobdogla Irrigation and Steam Museum

**Former Use (if any):** Irrigation of the Cobdogla, Loveday and Nookamka areas

**Designer:** Herbert Alfred Humphrey

**Maker/Builder:**

**a) Pumps:** William Beardmore & Co, England, to designs of H.A. Humphrey and Pump & Power Co. Ltd.

**b) Gas generating plant:** Messrs. May Bros. of Gawler to designs of W.F. Saunders, AMIE Aust

**c) Instillation and Site Work:** Irrigation Department of the Engineering and Water Supply Department

**d) Local Representation of Pump Makers:** Clutterbuck Bros. of Adelaide.

**Year Started:** 1922

**Year Completed:** 1925

### Physical Description:

The Cobdogla Pumping Station consists of two Humphrey pumps and a gas producing plant. The two 66" diameter pumps are of identical design, and lie on a single concrete foundation. Appendix A shows the layout of the pumps at Cobdogla.

The 6'6" (1981 mm) diameter combustion head (made from 2.5 inch thick cast iron) connects to a 5'6" (1676 mm) diameter 'U' shaped playpipe, which leads to a 4' (1219 mm) diameter discharge pipe. Large amounts of concrete reinforce the penstock wall and bends in the playpipe and caisson floor to absorb shock from the pump as it works.

The pumps use producer gas as fuel, having an average gas consumption of 18 082 cubic feet (512 m<sup>3</sup>) per hour. The pumps lift water 27 feet (8.2 m), previously 34 feet (10.4 m), from the River Murray to an irrigation delivery channel.

Combustion of the gas fuel propels the water column 'piston'. The pump works on a four stroke cycle, averaging 9 cycles per minute. A description of the operation can be found in the Appendix B.

**Physical Condition:**

The two Humphrey pumps remain in excellent condition. One has been restored to working condition, operating at times for the Cobdogla Irrigation Museum, while the other has been made accessible to visitors for inspection. The pumps are no longer used for irrigation; they were replaced by an electrically-driven Harland Uniglide pump in 1965.

**Modifications and Dates:**

**1928:** The Humphrey pumps were redesigned in October 1928 when one of the cast iron combustion heads cracked on the 15<sup>th</sup> of that month. Both heads were replaced with newly designed cast steel heads, incorporating improved valves and operating gear.

At this same time the combustion chambers were raised 7 feet due to the increased pool level of the river as a consequence of a lock and weir (no. 3) built downstream. This was achieved by inserting a 7 foot standpipe between the underside of the combustion chamber and the bend in the playpipe. This rise in the combustion chamber enabled a reduction in the lift of water and hence a reduction in fuel requirement. These modifications were completed on the 29 May 1930.

**1985:** In early 1985, restoration began on one of the pumps; it had not been used since 1965. This restoration involved the installation of a new 48 inch diameter steel pipe between the outlet tower and the receiving basin (the original piping having been removed), and all the bolts in the combustion head were replaced with studs as a precautionary measure. The exhaust belt and tower were corroded and underwent extensive repairs. The valves in the combustion chamber were in good condition, and only required cleaning and the replacement of rubber seals and gaskets. The ignition system required new wiring and the ignition coils were replaced by "T" Model Ford trembler coils obtained from a vintage car parts dealer. Two gas producers were purchased from Murtoa, Victoria, to supply the fuel for the pump.

The second pump was fitted with stairs and lighting to enable visitors to inspect it.

**Historical Notes:**

The Humphrey pump was invented by Herbert Alfred Humphrey, a Chemist and Gas Engineer from London. During the time he was employed by the Mond Gas Co. Ltd., he was provided with all the power and materials required for him to carry out experiments, as was required by his contract. It was here that the idea of the pump began. The first successful 4-stroke experimental pump was constructed in early 1908. The pump was awarded two 'Grand Prix', one in the class for gas engines, the other in the class for pumps.

In 1921 the decision was made to expand the steam-powered pumping station at Cobdogla for irrigation demands. The Humphrey pump was considered, along with steam and gas engines. As electricity was not yet reticulated to the area and diesel engines were not yet fully accepted in South Australia, these were not considered feasible options. Firewood supplies (the fuel at the time) were becoming depleted and thus the efficiency of the proposed plant was of great importance. The Humphrey pump was found to be favourable, resulting in savings of fuel and operational costs.

The pumps ran successfully between 1927 and 1965 (except during the two years when modifications were required). The pumps have now been replaced with an electrically-driven Harland Uniglide pump.

**Heritage Listings (information for all listings)**

**Name:** Register of the National Estate

**Title:** Historic

**Number:** 7832

**Date:** 21/10/1980

**Name:** Register of State Heritage

**Title:** Historic

**Number:** 10275

**Date:** 28/11/1985



## **2. ASSESSMENT OF SIGNIFICANCE**

### **Historic Phase:**

The semi-arid area of the Berri-Barmera council relied heavily on income from farming, which was dependent on irrigation from the River Murray. Settlement along the River Murray increased dramatically after World War I as returned soldiers were provided with land. This greatly increased the demand for irrigation, and thus there was a need to expand the existing steam powered pumping station at Cobdogla.

At the time the Humphrey pumps were commissioned, wood was the only practical fuel available. The officers of the Engineering and Water Supply Department from South Australia were aware that the resource was limited and therefore that the efficiency of the proposed plant was significant. In the end it was the efficiency of the Humphrey pumps that made them preferable to steam and gas engine pumps.

The pump represents a milestone in the progression of engineering large plants.

### **Historic Individuals or Association: Herbert Alfred Humphrey**

HA. Humphrey was an eminent Chemist and Gas Engineer, born in London in 1868. He was educated at Finsbury Technical College, and the Central Institution of the City of Guilds, Kensington. He worked four years with Messrs. Heenan and Froude at Manchester, and then moved on to Messrs. Brunner Mond & Co. in Cheshire. He developed an interest in the Mond gas producer process, in particular, its application to large power plants. He visited America for research on large power stations. On his return he established himself as a Consulting Engineer with strong association with the South Staffordshire Mond Gas Co. Ltd. The company hired HA. Humphrey to undertake experiments relating to industrial operations. It was here that the idea of the pump was developed and tested.

### **Creative or Technical Achievement:**

The pump works with high efficiency and strength without the use of any rotating flywheel, solid piston, connecting rod, rotating crank or bearings of any kind. The pumps work essentially as a four stroke engine, with water as the moving piston. It is the simplicity and elegance of the design which makes it so unique.

### **Research Potential:**

There has been some interest in the use of Humphrey pumps in third world countries. The simplicity of the pump and lack of moving parts means that the manufacturing process is simplified and maintenance is reduced – making them a suitable option for poorer countries. The flexibility of the fuel supply is being investigated, with the possible use of wood, dried dung, methane or natural gas.

A group of researchers at the University of Reading has since constructed two experimental pumps, with the aim to understand, measure and optimise its operation. Another group at the University of Texas is currently working on constructing a two stroke cycle pump.

### **Social:**

From 1927-1965 the two pumps were the lifeblood of the community which was based around irrigation from the river for farming. The pumps are also a representative example of a successful attempt to reduce the consumption of firewood as fuel while maintaining efficiency.

Now, the pumps form part of the Cobdogla Steam and Irrigation Museum that is run by volunteers from the community. The working pump runs at times during the year, attracting visitors both locally and interstate.

### **Rarity:**

One of the Humphrey pumps at Cobdogla is the only remaining working pump of its kind in the world. The two pumps which were installed were the only two of their type in the Southern Hemisphere. It was the second largest installation of Humphrey pumps in the world (second only to the four installed at the Chingford plant, London).

There has been no further development on the design of the Humphrey pump.

**Representativeness:**

The Humphrey pumps are both representative examples of the gas engine pumps.

**Integrity/Intactness:**

The two Humphrey pumps remain in excellent condition. One has been restored to working condition, operating at times for the Cobdogla Irrigation Museum, while the other has been made open to visitors for inspection.

**References:**

Connell J.E. 1980, *Australian Heritage Engineering Record: Humphrey Pumps Cobdogla, S.A.*, survey no. SA9, Heritage Unit, Department for the Environment, Kent Town.

Forward P.D. & Subagio N. 1986, 'Restoration of a Humphrey Pump to Full Operation', *3<sup>rd</sup> National Conference on Engineering Heritage*, Adelaide 1-3 December 1986.

Hodrien C. 1987, 'Where's the Piston?', *Bulletin*, 9(4): 22-42.

Smith, D. 1970, 'The Humphrey Pump and its Inventor', *Excerpt Transactions of the Newcomen Society*, XLIII

Wasley D. 1995, 'The Humphrey Pump', *Australian Steam Power*, 16: p6.

Wasley D. 1995, 'The Humphrey Pump continued', *Australian Steam Power*, 17: p. 6-7.

Wasley D. 1996, 'The Humphrey Pump continued', *Australian Steam Power*, 18: p7-9.

**Statement of Significance:**

The Humphrey pumps at Cobdogla are of high historic and technical importance. Historically, one of the pumps is the only working example of the Humphrey pump in the world. The pumps were the only two of their kind to be installed in the Southern Hemisphere. The Humphrey pump is a simple and elegant design because of the elimination of all moving parts (with the exception of the spring loaded valves), the water column acting as the piston. It has the ability to work with high efficiency at low fuel consumption. The unique design of the Humphrey pump, which has not been advanced, further enhances the historical significance of the Cobdogla pumping station. It is a rare example of a milestone in the progression of engineering large plants.

Furthermore, because of the simplistic design, the pump is of technical importance, with potential for research. These pumps are currently being investigated as an option for power supply in third world countries due to the minimal costs of construction and maintenance. Also, the flexibility of the fuel supply has large potential for use in these areas.

The pumps now form part of the Cobdogla Irrigation and Steam Museum that is run by volunteers from the community. The working pump runs at times during the year, attracting visitors both locally and interstate.

**Assessed Significance:**

National

**Images with captions:**



Photo 1: Cobdogla pumping station which houses the Humphrey pumps.



Photo 2: Top view of one of the pumps, taken from ground level. The green structure is the combustion head. The canopy above the pump is connected to a ventilating fan to remove any escaping gas.



Photo 3: the gas bags with the gas supply pipe and valves at the front. The gas pipes to the pump can be seen at the rear of the distant bag.



Photo 4: The top of the water tower, which sits below ground. The water in this tower rises and falls as the pump operates.

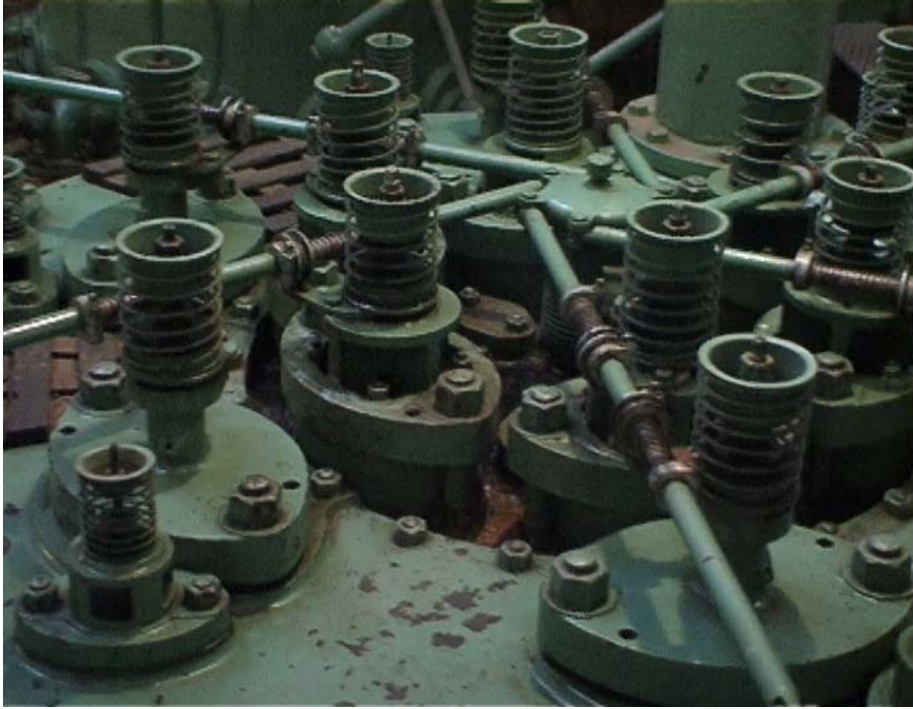


Photo 5: mixture inlet and scavenge valves on the combustion head of the pump

## **Proposed wording for information plaque**

### **NATIONAL ENGINEERING LANDMARK**

#### **Humphrey Pumps, Cobdogla**

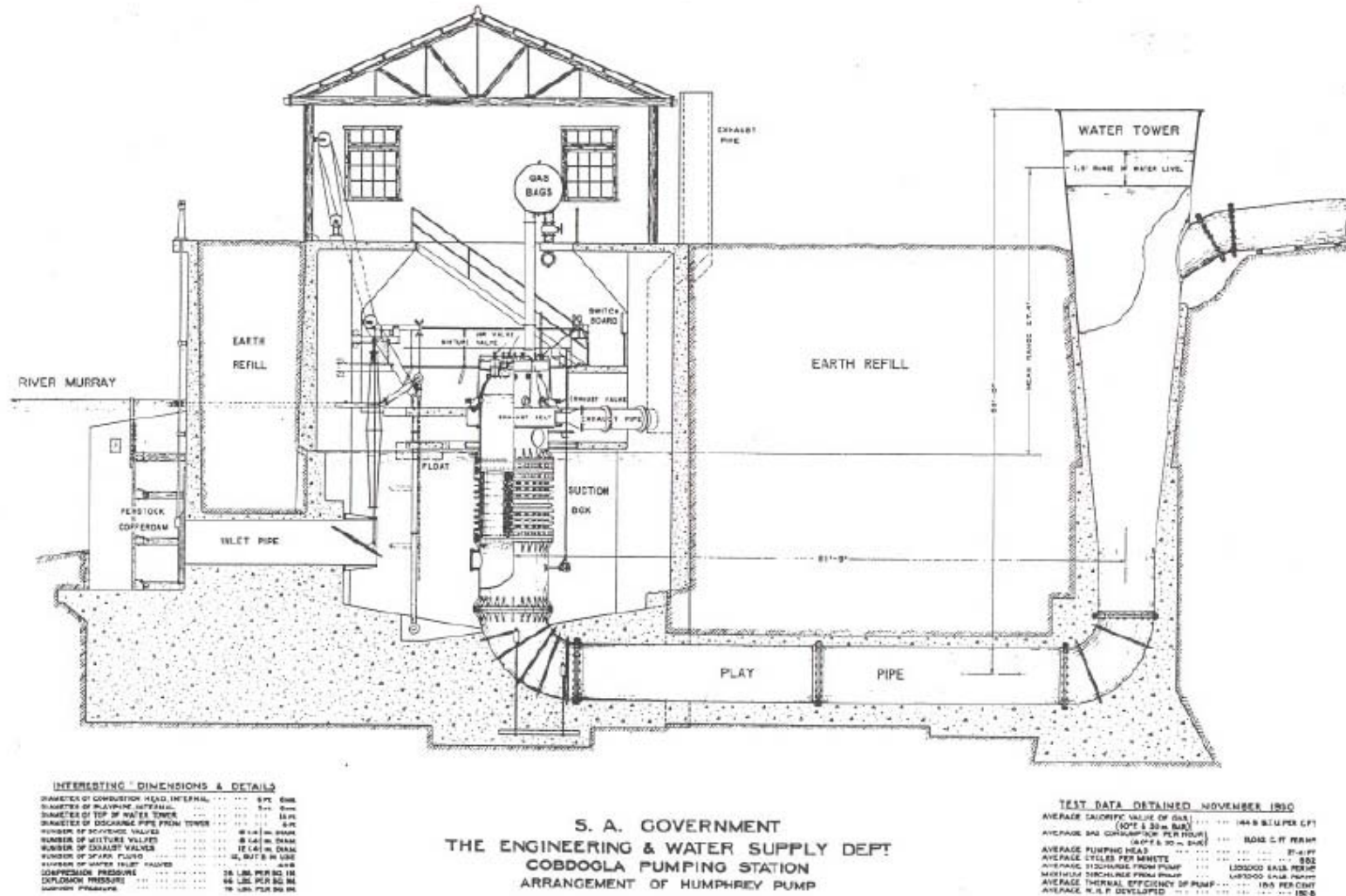
The Humphrey Pumps at Cobdogla were used for irrigation between 1927 and 1965. The pumps were built to the design of HA Humphrey who developed this elegant system essentially free of moving parts. Combustion of gas provides the force necessary to move a column of water which acts as a piston in a four stroke cycle. The pumps were the only two of their kind to be installed in the Southern Hemisphere. The one working pump is the only operational Humphrey pump in the world.

The Institution of Engineers Australia

SA Water

Word count: 85

## Appendix A: Details of the Humphrey pump design



Taken from: Forward P.D. & Subagio N. 1986, 'Restoration of a Humphrey Pump to Full Operation', 3<sup>rd</sup> National Conference on Engineering Heritage, Adelaide 1-3 December 1986.

## Appendix B: Details of the pump operation

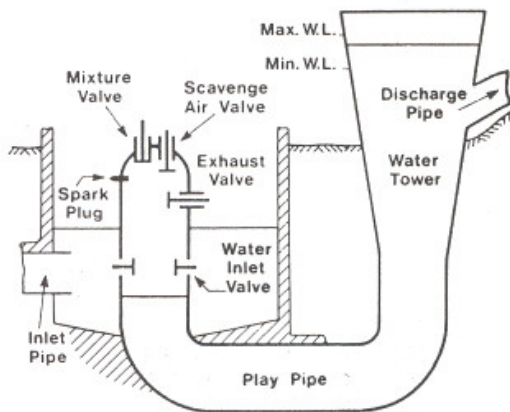


Figure 1 First Outward Stroke

The first outward stroke acts like a water cannon. Water is forced up to tower and out of the discharge pipe. Towards the end of the stroke the water inlet, scavenge air and exhaust valves all open. The inertia of the moving column of water has now created a partial vacuum, and water and air enter the combustion chamber.

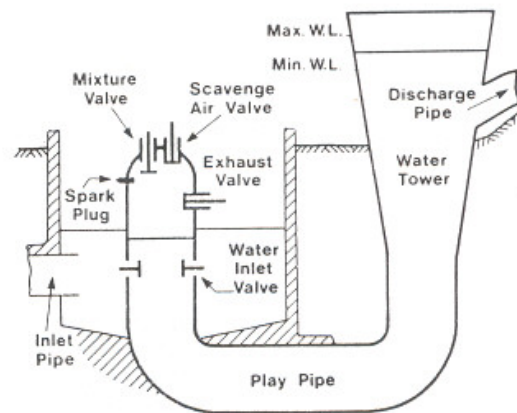


Figure 3 Second Outward Stroke

This compressed air now forces the water outward again. The inertia of the water column takes it past the point where pressure in the combustion chamber is equal to air pressure; the mixture valves open and a new charge of air and gas is drawn into the partial vacuum so created.

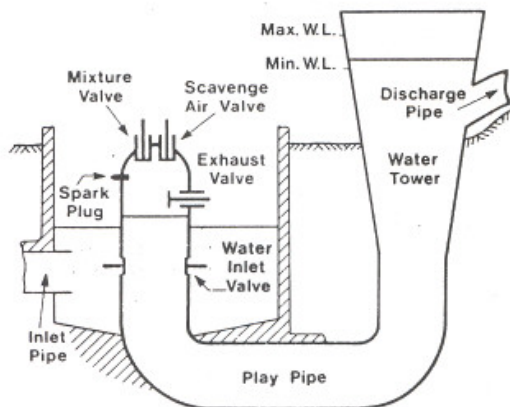


Figure 2 First Return Stroke

The column of water starts to fall back because of the force of gravity. The inlet and air valves close. Most of the spent gases are forced out; the moving column of water compresses the air above the exhaust valve level and comes to rest on the cushion of compressed air so formed.

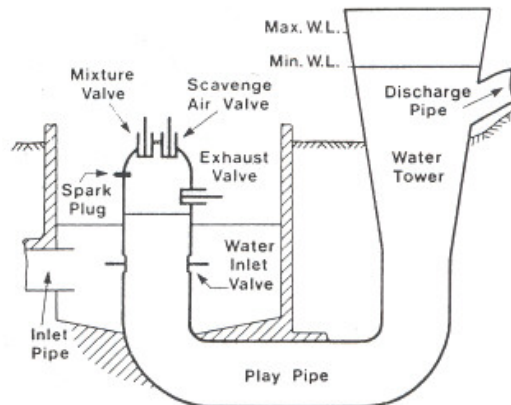


Figure 4 Second Return Stroke

The water falls back in the tower again. All valves close, the explosive mixture in the combustion chamber is compressed, ignited by the spark plugs and the cycle starts again. There are nine complete cycles per minute.

**Taken from:** Forward P.D. & Subagio N. 1986, 'Restoration of a Humphrey Pump to Full Operation', 3<sup>rd</sup> National Conference on Engineering Heritage, Adelaide 1-3 December 1986.



20 August 2008

26 AUG 2008

**SOUTH AUSTRALIAN  
WATER CORPORATION**

Mr Ian McEwan  
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Dear Mr McEwan

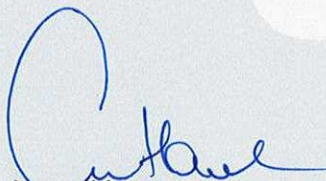
**Re: Humphrey Pumps, Cobdogla**

Thank you for your letter dated 16 May 2008 regarding the intention of the South Australian branch of the Engineering Heritage Association to put forward a submission to Engineering Heritage Australia for the Humphrey Pumps at Cobdogla to be awarded the status of a National Engineering Landmark.

As the owner of the Humphrey Pumps at Cobdogla, SA Water wholeheartedly supports this initiative and you have our approval to proceed with the submission of the nomination.

Should you need any assistance with the preparation of the nomination or require any other information, please liaise with Mr Peter Forward, Manager Salinity Control, telephone 8207 7725 or email [peter.forward@sawater.com.au](mailto:peter.forward@sawater.com.au).

Yours sincerely



Anne Howe  
**CHIEF EXECUTIVE**