LAB SCALE
D.C. ELECTROMAGNETIC CONDUCTION PUMPS

CUSTOMER DRIVEN SOLUTIONS
LAB SCALE D.C. ELECTROMAGNETIC CONDUCTION PUMPS

FEATURES

1. Continuous operation at liquid metal temperatures to 1600 °F (871 °C)
2. No moving parts -- no seals -- no packing glands -- no leaks.
3. Flow control from 10 to 100 % of capacity with no throttling valves resulting in wide range of flow rates available
4. Low maintenance – reliable to 20 years or more
5. Operable in radiation fields.
6. Small footprints ~ 10” wide x 10” long x 12” tall depending upon design

PRINCIPLE OF OPERATIONS

Creative Engineers, Inc.’s Lab Scale D.C. Electromagnetic Conduction Pumps operate on the principal that the liquid metal is a conductor of electricity. When electrical current passes through the pumping section perpendicular to the magnetic field, a force is produced in the liquid metal within the pump that is at right angles to the current and the magnetic field.

The flow rate of CEI’s lab scale electromagnetic pumps can be positively controlled from zero to maximum from an optional CEI provided control panel.

Standard pumps require an electrical supply of 240 Volts, single phase, 60 Hertz. Special construction is available to allow operation on 480 VAC, 60 Hertz power supply.

BENEFITS

- No need to develop a pump, stay focused on your research objectives.
- Easily variable flow to match your test apparatus.
- Priced with limited R&D budgets in mind.
Photographs of CEI’s Lab Scale Electromagnetic Pump are shown below:

APPLICATIONS

The example performance data shown below was obtained from a single stage pump system and a four stage pump system using sodium-potassium (NaK) alloy at ambient temperatures. Other pump sizes and flow rates are available. CEI pumps will handle liquid metals including sodium, potassium, cesium, lithium, lead, gallium, mercury, and their alloys. This data is for a specific system and custom pump tube design. Further data can be supplied upon request. CEI can build, test and deliver custom pumps and systems based on customer needs.
<table>
<thead>
<tr>
<th>Power % of Max</th>
<th>Max Flow Gal/hr</th>
<th>Max Discharge Pressure PSI</th>
<th>Max Flow Gal/hr</th>
<th>Max Discharge Pressure PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.0</td>
<td>1.8</td>
<td>3.5</td>
<td>1.3</td>
</tr>
<tr>
<td>40</td>
<td>3.9</td>
<td>8.5</td>
<td>60.0</td>
<td>17.0</td>
</tr>
<tr>
<td>100</td>
<td>50.0</td>
<td>15.0</td>
<td>90.0</td>
<td>28.0</td>
</tr>
</tbody>
</table>

This pump will operate at any point at or below the data points. The pump is a pressure device; and with a fixed applied voltage, flow will be established according to the pressure drop in the system external to the pump.

The performance of any given pump will vary somewhat with the type of fluid, temperature and materials of construction. Pumping in the conduction type electromagnetic pump requires that the liquid metal wet the pump tube for best performance. It is best to select a pump with a maximum performance above the expected normal operating point or to specify required performance and details of the application so that the appropriate pump may be recommended.

A Type 316 stainless steel pump tube is normally supplied. Other tube materials may be used provided they are non-magnetic and are compatible with the fluid to be pumped.

INSTALLATION

Pump installation is quite simple, whether it is to be used in a continuous loop or in an open system. The pump is supplied with tubing ends for connecting to piping systems. An eye hook or hanger is provided from which to support the pump. The pump is too heavy to be supported by the connecting piping. The pump is able to be supported from the bottom; however, provisions must be made to maintain air circulation through the pump cage.

The important factors which determine where the pump should be placed in a system are as follows:

1. The pump must be located in such a position that it will be flooded before and during operation to prevent the high secondary armature current from
overheating the pump tube. An inlet pressure at the suction end of the pump of a least two feet of liquid metal above the vapor pressure should be maintained.

2. Piping stress due to thermal expansion and contraction of the system must not place a strain on the pump in such a manner as to rupture or cause permanent distortion of the pumping section. The pump is modeled in the run as a straight piece of tube with one vertical hanger at the pump frame support.

3. The maximum rated operating temperature of the pump must not be exceeded. Ambient temperature should be maintained below 150 °F. For maximum life, forced air cooling should be supplied on all pumps which will handle fluid at temperatures above 1,400 °F continuously. An open construction is used on the pump to permit natural circulation of air for cooling.

All CEI conduction pumps are supplied with special tubular electrical heating elements for preheating purposes when pumping a material which is solid at room temperature. The heater should be used only for preheating and should be turned off when the pump is operating.

If the cover gas or liquid metal vapor is trapped in the pumping section, pumping will stop immediately; and the secondary current will cause rapid heating of the pump tube. To prevent damage, a relay should be provided which will shut off power to the pump when the flow drops below a preset value to prevent pump damage. CEI can advise on this value depending the operating conditions of the pump and its system.

OTHER EQUIPMENT AVAILABLE FROM CEI
- Large EM Pumps to 150 gpm+
- High temperature pressure transmitters
- Plugging Temperature Indicators
- Flow Meters
- Complete liquid metal systems

Creative Engineers Inc.  Phone (443) 807-1202  info@creativeengineers.com  www.creativeengineers.com
CEI ALSO PROVIDES COMPLETE SYSTEMS

CEI has the engineering capability to design and build your turnkey custom:

- Pilot plant or R&D Unit
- Benchtop unit
- Lab Scale set up
- Demonstration unit
- Skid mounted system
- Production System

Further, CEI has the facilities and personnel to operate this unit to help achieve your goals including:

- Proof of Concept
- Technology Evaluation
- Technology Extension
- Process Development
- Milestone Data for Investors
- Economic Feasibly

**Commercialization**

CEI’s experienced staff in chemical operations can operate your research system to achieve your objective. We will collaborate with you to develop and adapt the best testing plan. We can provide a wide variety of services to support your goals. Including:

- Dedicated and Focused Resources
- Rapid Work Pace
- Commissioning and Start up
- Site Access to Witness Operations
- 24 hr Research Operations
- Process Data Analysis
- Quality Result Analysis
- Secure US site for IP protection
Customer Testimonials

“My solar energy company has worked very intimately with Rich and the CEI team for almost 3 years now and we have been very impressed. They consistently deliver creative solutions to our most challenging design and engineering problems while also being very hands-on: building new equipment and running experiments. Their flexibility was incredible--often traveling to our site for meetings, and even hosting most of our pilot plant operations at their facility when we couldn't get our own permits in time.

Rich has assembled a hand-picked team of chemical, process, mechanical and electrical engineers and their cumulative expertise has both great depth and breadth. They are a lean-running machine that operates with great integrity.

I highly recommend the CEI team to any client seeking contract engineering that requires very creative solutions, pilot plant design for challenging processes that have never been done before, and anything involving hazardous materials such as Alkali metals.”

“Working with Creative Engineers, Inc. has been a critically valuable part of our company’s growth. Creative Engineers’ technical expertise, combined with quick response times and a collaborative problem-solving approach, was a crucial element in achieving our company’s initial goals. By utilizing their staff’s various engineering expertise, Creative Engineers was able to provide our small company with the technical knowledge and design experience to build an oil processing pilot plant”…

“Their ability to create a skid mounted system that was transported to our facility assured us of remaining on-schedule with minimal complications. Once the system was in place, Creative Engineers continued to assist us with various technical obstacles and remained an important part of our support staff. Based on the success of this first pilot plant, we are scaling up our project and have asked them to help build our first fully automated demonstration facility.

A rapidly changing industry, combined with experimental procedures and new technology, requires our company to react quickly to new information. On several occasions, we asked Creative Engineers to implement changes to a design or consider new constraints. In most cases, we could not give them much time to adapt to these new situations. Without fail, they succeeded in meeting our expectations, and in most cases, exceeded them.”

“Rich offers unique perspectives and sound business acumen to projects and overall program development. My professional and personal experiences with Rich, along with his colleagues at Creative Engineers, have always been positive experiences. I look forward to working with Rich on future projects, and I highly recommend Creative Engineers wherever creative and innovative engineering expertise is needed.”

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