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ORNL PUMP BROCHURE

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The ORNL pump was designed and developed in the Reactor Experimental Engineering Division of Oak Ridge National Laboratory to make available to the Division and the Laboratory a small, inexpensive pump in a class that was not available from any pump manufacturer.

In general, the ORNL pump is a high suction pressure, high temperature, totally enclosed, chemical pump capable of outputs of 0 to 20 GPM at approximately 40 feet of water head.

The pump is a totally enclosed, leak proof pump which uses no seals or stuffing box. Although the pump scroll has a stainless steel gasket for use in most application, the scroll can be seal welded to the pump housing to assure leak free operation. The pump will operate with a suction pressure from atmospheric to 1000 psi and circulate chemicals up to a temperature of 250°C (482°F). Somewhat higher circulating fluid temperatures are possible if the pressure does not increase above 1000 psi and the temperature in the back of the pump stays below 100°C.

All the materials used in the pump which are subjected to the circulating fluid are selected for their good corrosion resistance. All construction materials are of type 347 stainless steel, however, in the back of the pump there are bearings constructed of Graphitar #14 and a rotor which has a chrome plated journal. The back of the pump is cooled to give the Graphitar and chrome plate the advantage of low temperatures in resisting any chemical action. The cooling also aids in keeping the stator temperature low.

The Pump Unit

The pump will be made up as shown on Drawing TD-D-2359 and will include the assembly of all cooling tubes as indicated on Drawing TD-C-2384. The scroll will have a tangential outlet suitable for discharging fluid from the pump when the impeller rotates counterclockwise as observed from the scroll end. Two capacitors to be included in the electrical connections to the pump as indicated on Drawing TD-C-2416 will be part of the pump unit, however, the electrical lines will have to be run and connected at final installation.

The pumps will have been run at a suction pressure of 1000 psig for a minimum of 15 minutes and will have been pressure checked to 1500 psig. A head capacity curve will be available on each pump.

Mounting brackets, base or a shaft puller will not be provided with the pump.

No instrumentation is required.

The discharge and suction connection to the pump are 3/4 I.P.S. Schedule 80 pipe beveled for butt welding.

Mounting

Supporting the pump in a horizontal position can easily be accomplished by a clamp or strap that will fit around the heat exchanger at the middle of the pump. An alternate method is to provide one bracket through which at least two flange bolts could extend before the nuts are placed on the bolts.

Assembly

In this discussion, Drawing TD-D-2359 will be referred to.

To assemble the pump, slip the bearing (Item 10) over the rotor shaft (Item 21) and lower it into the housing (Item 16), which should be in a vertical position. The impeller screw (Item 12) could be attached to the end of the rotor loosely to provide a finger grip. The bearing should then be pressed into the housing with the hand to some intermediate depth relative to its final position. If the rotor is held up from the bottom of the housing, the journal will act as a guide for the bearing as it is pressed into the housing. A space between two of the three longitudinal grooves in the bearing should be located below the journal on the rotor in the final mounted position. The spacer (Item 8) and labyrinth (Item 14) should then be slipped over the shaft and pressed down with the hand or lightly tapped down pushing the bearing before them until the labyrinth seats on the shoulder in the housing. This method gives the bearing its correct position in the housing. The labyrinth has one shoulder slightly larger than the other, the smaller end is fitted over the shaft and lead into the housing first; this end is marked with an "I" and should also have the serial number of the pump. The labyrinth back up plate (Item 13) is then slipped over the shaft and tapped down until solidly against the labyrinth. The labyrinth back up plate is a press fit in the housing and should hold all the members of the pump in the correct position during any operation, however, if it fits loosely, the housing can be deformed to press against the plate thus holding it in position by using a center punch very lightly at the periphery of the plate at two or three points.

After the labyrinth is against the shoulder and again after the labyrinth back up plate is in position the axial movement of the rotor should be measured to assure it has a movement of from 0.015 to 0.050 inches.

The impeller (Item 20) is then put on the shaft and pulled up tight with the impeller screw. The scroll (Item 4) can then be located on the housing with the gasket in place and pulled up tight with the bolts. The scroll should be located so the opening from the scroll is at the top of the pump and the tangential outlet is horizontal to minimize any gas binding tendency. The gasket provided is 347 ss, however, teflon could be used for low temperature work where the teflon is compatable with the solution being circulated.

Disassembly

After the scroll and impeller have been removed from the pump, and it is desired to remove the rotor from the pump housing, the rotor

bearing, spacer, labyrinth and labyrinth back up plate can be pulled at one time by using the shaft puller shown on Drawing TD-C-2358. It is recommended that this item be made for ease of disassembly.

General Operation

The pump is capable of operating with a suction pressure from atmospheric to 1000 psi. The pump is designed for circulating fluid with temperatures from atmospheric to 250°C (482°F). Higher temperatures are possible if the suction pressure is kept at 1000 psi or below and the temperature at the back of the pump is kept below 100°C.

The pump is designed to isolate a portion of the circulating liquid in the back of the pump and keep it cool by means of a cooler jacket on the outside of the housing. The components in the back of the pump are in turn cooled by circulating the isolated cool fluid through them by means of a small impeller located at the back of the rotor. The cool fluid in the back of the pump also aids in cooling the stator, however, the stator is also cooled by cooling tubes layed into its iron laminations.

Sufficient cooling water should be available to the stator cooling coil and pump cooling jacket to maintain the proper temperatures. A minimum of 3 GPM cold water total should be provided to the parallel connected coolers just prior to and during operation. This flow rate will circulate 1/4 GPM through the stator cooler and 2 3/4 GPM through the pump cooler.

At 3 GPM cooling water flow rate, approximately one K.W. of heat will be removed from the main circulating stream if the stream is at 250°C. This should be provided for in the design of the circulating system.

There is a connection provided at the back of the pump which should be located at the highest possible elevation for bleeding off any trapped gases which would interfere with the circulation of the cooling water. This connection could also be used as a drain and located at the lowest elevation, however, the system would have to be vacuumed before the system is filled with fluid to assure proper filling of the back of the pump. It also could be used as an injection line for the pure liquid carrier of a slurry when its desired to pump slurry.

The pump will, in general, permit a large percentage of gas to be pumped in the circulating fluid without gas binding. When gas binding does occur, however, the thrust load on the rotor changes from a direction towards the thrust bearing to a direction towards the back of the pump and the rotor starts rubbing on the back of the pump. An unfavorable operating condition of the pump will be indicated by the rubbing noise, and the pump should be stopped as soon as possible.

Alternate Methods of Operation

The standard electrical connection to the pump is shown on TD-C-2416 and in Figure I. The characteristic curves of the pump

when connected in this manner are shown in Figure 3.

An alternate electrical connection is shown in Figure 2, however, the head output of the pump is somewhat lower than in the standard case. The characteristic curves resulting from the alternate electrical connection are shown in Figure 4.

A special application of the pump necessitated the design of a scroll with an axial rather than tangential outlet. The axial scroll is shown on TD-D-2335. The characteristic curves with the standard electrical connections are shown in Figure 5.

Starting Pump

When the pump has been installed, as described before, starting and normal operation can be achieved by the following steps:

1. Fill system with fluid taking care to fill the back of the pump either by vacuuming the system prior to filling or by bleeding the back of the pump.

2. Turn on cooling water to approximately 3 GPM flow rate.

3. Turn switch to start position and hold for approximately two seconds and release so switch can spring back to the run position.

As a caution it should be remembered that if the particular system in which the pump is mounted has a variable load, the pump should be started against the maximum load or in a shut-off condition and then brought to higher outputs by reducing the load. If the load is fixed and within the capacity limitations of the pump, it is alright to start under these conditions. Do not try to run or start the pump at higher than 20 GPM output.

Welding Pump Closed

If it is desired to obtain an absolute leak tight system, the scroll can be seal welded to the housing as described below. It is recommended that the Heliarc technique be used in welding.

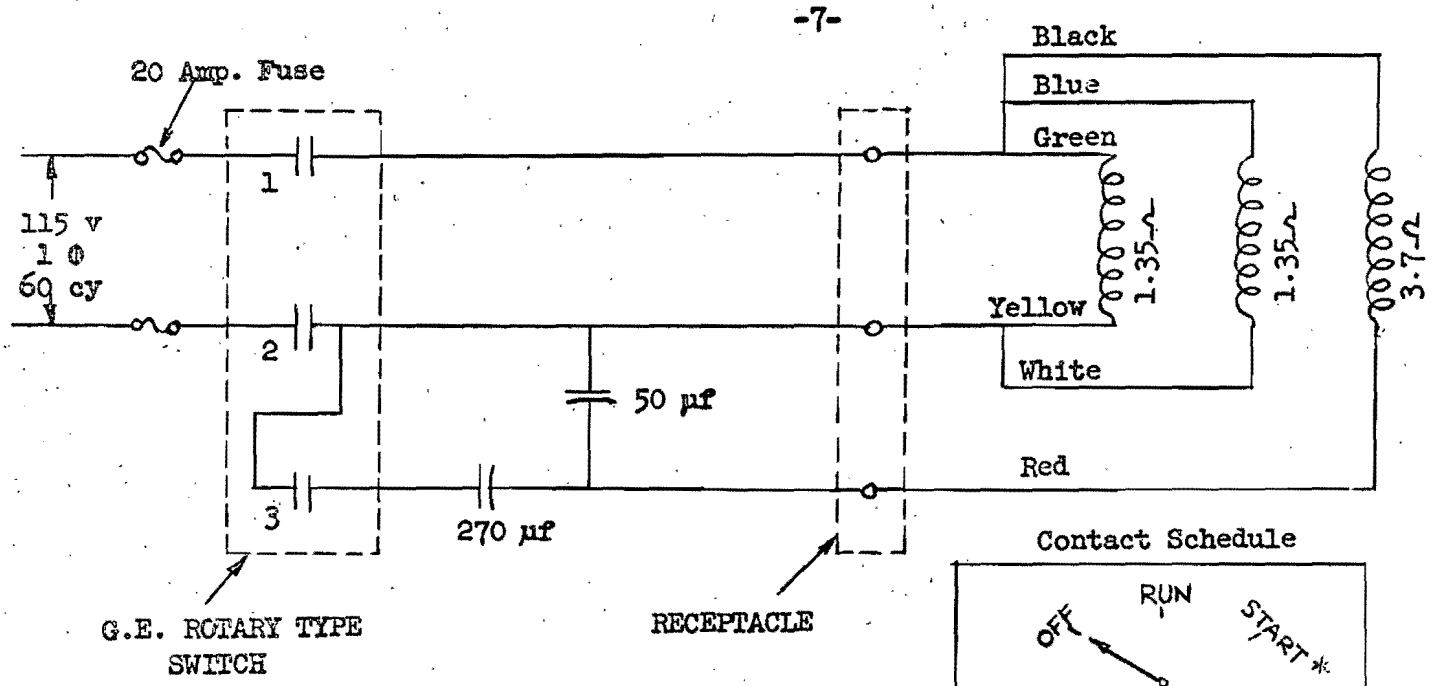
Prior to seal welding, the scroll should be pulled up tight to the housing with the flanges and bolts. The 347 ss gasket should be in its normal position. Seal weld between the bolts in six places; then, remove one bolt at a time and join the seal weld which was made on each side of it. Replace the bolt and tighten it after the weld is made underneath. In this manner the first pass can be completed around the scroll. The welding between the bolts and underneath the bolts should be done in an alternating pattern from one side of the pump to the other so the scroll will pull up evenly. The bolts can be removed after the first seal weld pass is complete so a second continuous pass can be made. After the welding is complete the flanges and bolts are replaced and the bolts should be pulled up tight.

The only other connection to the pump, which is the drain at the back of the pump, can also be plug welded.

List of Prints

The following is a complete list of all drawings on the pump.

TD-B-2367	Key
2372	Impeller Screw
2373	Labyrinth Back-Up Plate
2461	Housing Pressure Ring and Stator Locator
2501	Bearing Spacer
TD-C-2366	Front and Back Gaskets ORNL Pump
2374	Scroll, ORNL Pump
2375	Impeller
2376	Front Flange ORNL Pump
2416	Wiring Diagram for ORNL Pump
2427	Labyrinth ORNL Pump
TD-D-2359	ORNL Canned Rotor Pump
2378	Shaft Rotor Assembly
2379	Housing Assembly ORNL Pump
2380	Heat Exchanger ORNL Pump
2383	Modified Stator Including Cooling Coil 5 GPM ORNL Pump
2384	Piping for Heat Exchanger and Stator Cooling Coil ORNL 5 GPM Canned Rotor Pump
2491	Inserted Graphitar Bearing ORNL 5 GPM Pump
SK 224	Bill of Materials for Assembly TD-D-2359

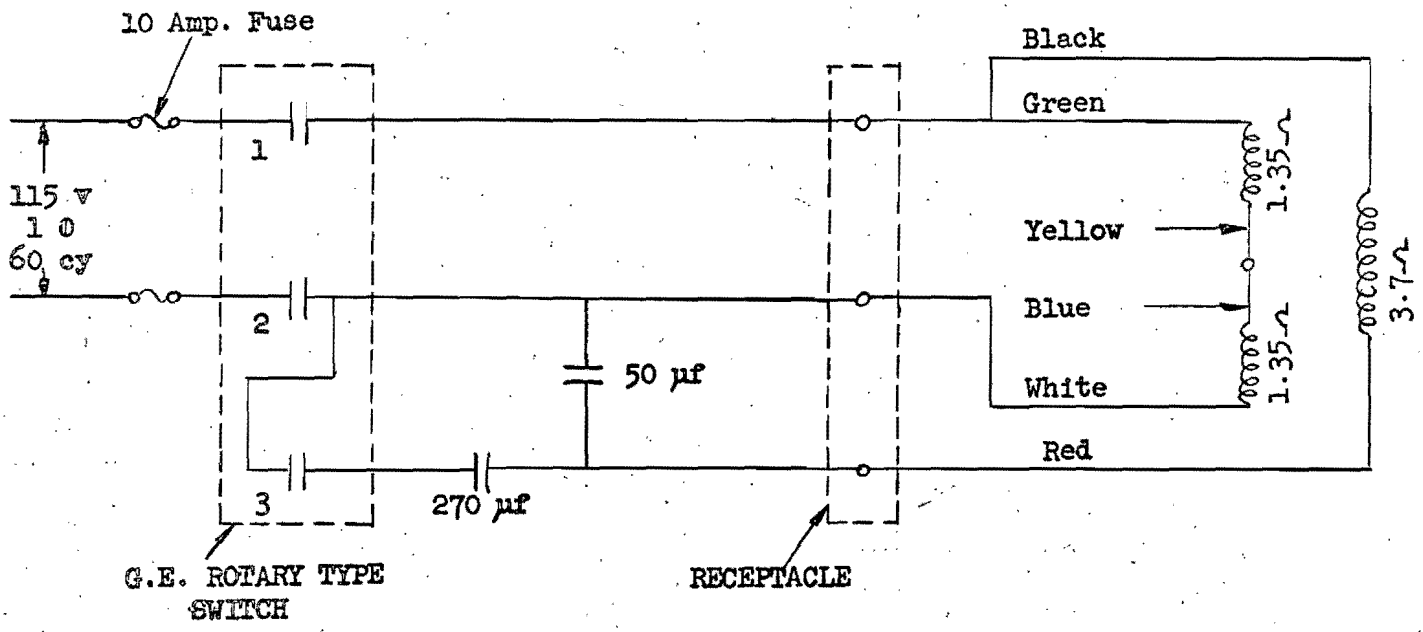


Contact Schedule

Position	Open	Closed
Off	1,2,3	---
Run	3	1,2
Start	---	1,2,3

* Start position is spring loaded
Color code indicated corresponds to
color of wire leads from stator

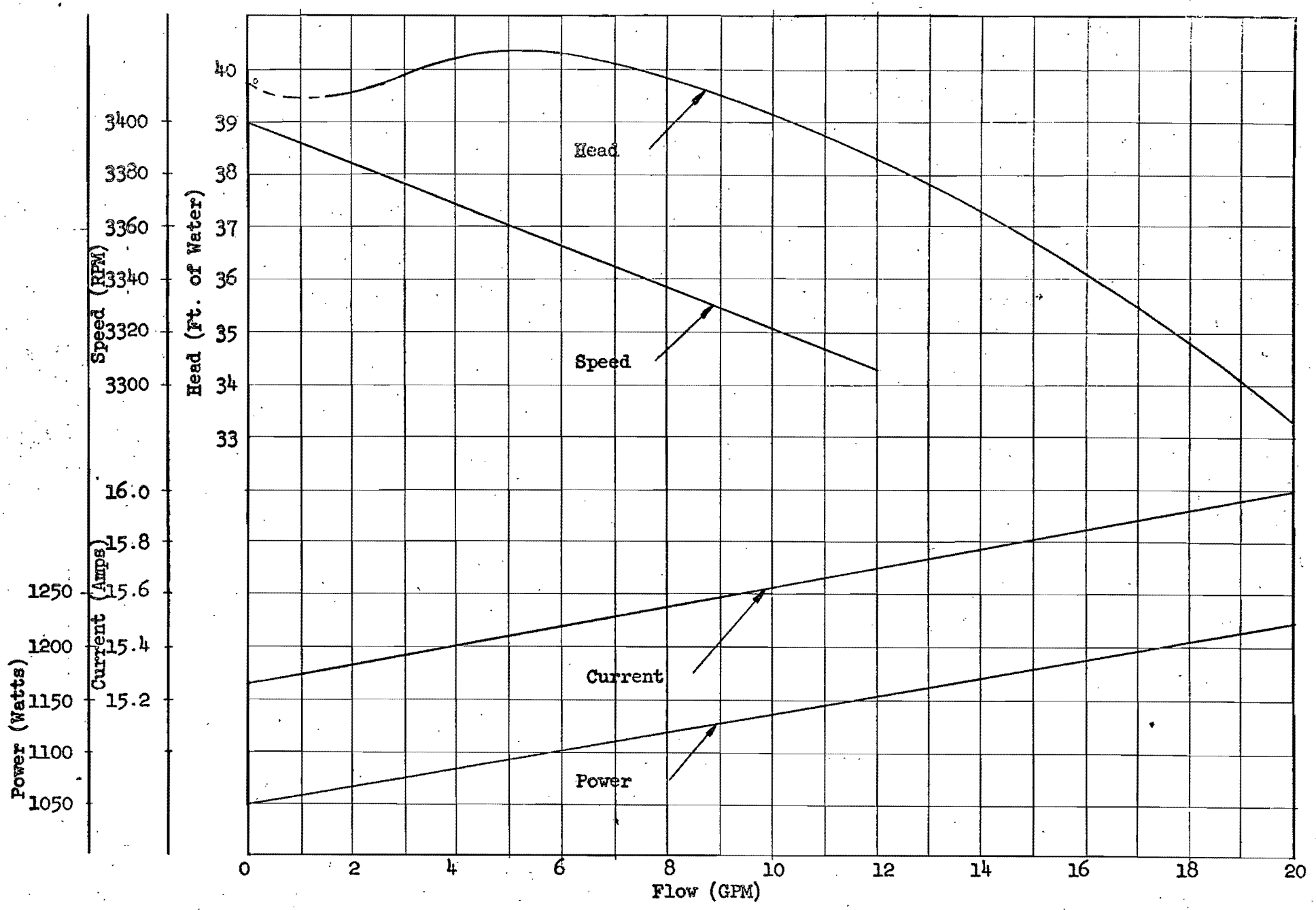
STANDARD WIRING DIAGRAM
FIGURE 1



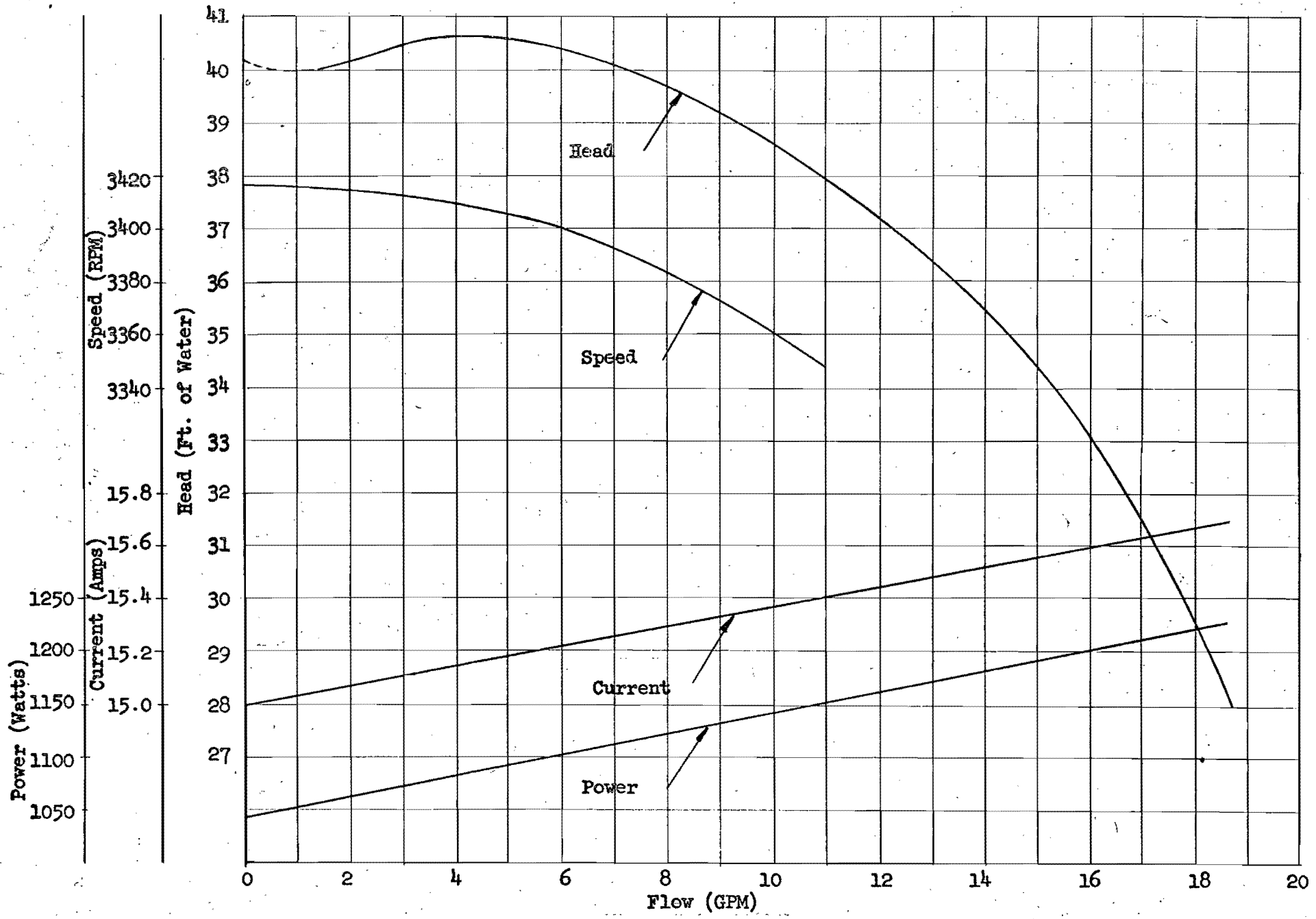
Color code indicated corresponds to
color of wire leads from stator

See Fig. 1 for contact schedule for rotary switch

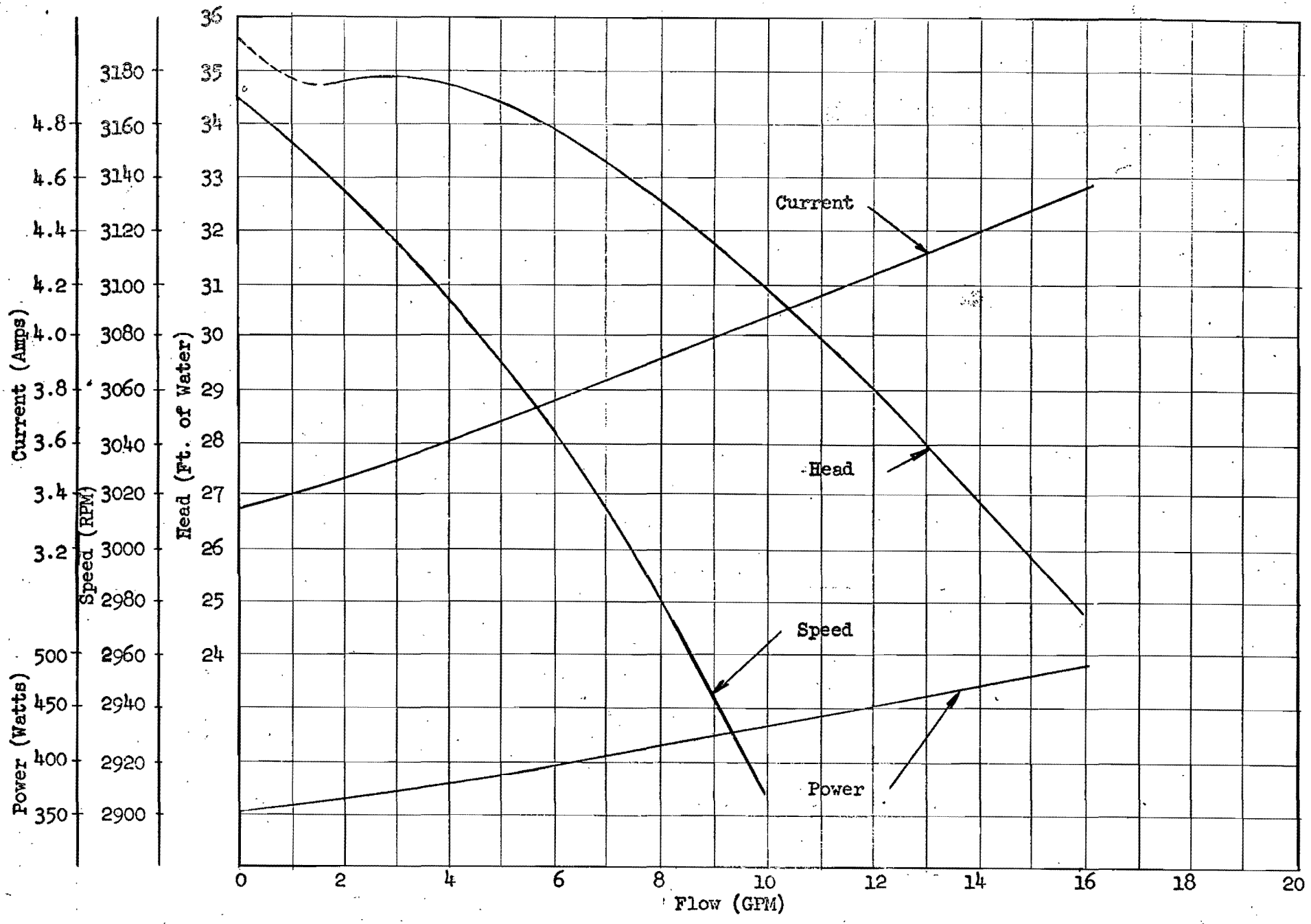
ALTERNATE WIRING DIAGRAM
FIGURE 2



ORNL Pump Characteristic Curves
STANDARD PUMP WITH STANDARD ELECTRICAL CONNECTIONS
FIGURE 3



ORNL Pump Characteristic Curves
AXIAL SCROLL PUMP WITH STANDARD ELECTRICAL CONNECTIONS
FIGURE 4



ORNL Pump Characteristic Curves
STANDARD PUMP WITH ALTERNATE ELECTRICAL CONNECTION
FIGURE 5

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