"A differential pump is practically a double-acting pump with but two valves. By arrangement as shown in Fig. 2, it will be seen that an equal amount of work is done on each side of the steam-piston during one revolution. In a single-cylinder double-acting pump four valves are required, one suction- and one discharge-valve for each end of the double-acting plunger. A single differential pump, however, requires but one suction- and one discharge-valve for but one of the plungers—the main plunger. The differential pump has the advantage of always being primed, as will be seen by referring to Fig. 2, where the column-pipe D, the discharge-space C, and the differential plunger-chamber are always in connection. Thus the total pressure due to water-head is always on the differential plunger H. In other words, as long as there is water in the column-pipe the pumping-engine will always have a resistance to overcome even should suction be lost. The arrangement, therefore, prevents undue hydraulic strains on the different pressure parts.

"Because of having half the number of valves this form of pump is simpler than the double-acting pump, and is used until the capacity becomes so great that the valves would become too cumbersome. When this capacity is reached it becomes necessary either to make a duplex or triplex differential, or to use a double-acting pump instead. The double-acting pump-valve would be half the size of the differential pump-valve for the same total capacity. When pumping against high pressures the air-chamber is made of seamless structural steel, or flange-steel, so as to prevent leakage of air. By referring to the illustration it will be seen that the water enters the suction-pipe A, passing into the suction air-chamber, and thence into the suction-funnel B. It should here be noted that the large casting (which acts as a substantial base for the pump) and the suction-funnel B form in the upper part of this casting a large suction-chamber insuring efficient action of the suction-valve E. When the main plunger J moves towards the right it draws a volume of water equal to its displacement through the suction-valve E. On its return to the left, the suction-valve having been mechanically closed, it forces a volume of water equal to its displacement through the discharge-valve F, half of this water passing out into the column-pipe D, the other half passing down and following the differential plunger H. The discharge-valve F now being closed, the main and differential plungers (which are connected by means of side rods) move again to the right, the main plunger again drawing the water through the suction-valve E, and the differential plunger displacing its volume and forcing same through the discharge-passage C into the column-pipe D.

"The cross-sectional areas of the main and differential plungers J and H are generally made in the proportion of about 2 to 1, so as to equalise the work done on both forward and return strokes—in other words, equalising the work as in the case of a double-acting pump. The rods G are the side rods connecting the cross-heads of main and differential plungers. These rods are always in tension.

"It will be noted that in the front of the discharge C, and connecting to the pipe-column D, is a clack-valve for the purpose of holding the water in the column-pipe when it is desired to take out the valves or examine interior parts of the pump. When the pump is working this valve is open, but can be closed when it is desired to stop the pump by means of a lever on outside of clack-valve chamber. These valves are especially necessary in pumps where either side may be run alone. It is a preferable form, because should an ordinary stop-valve be used instead more time would be consumed in closing same, and by carelessness it might not be opened when starting the pump, thus incurring liability to accidents. The clack-valve will open automatically as soon as the pressure inside of pump-body exceeds the pressure in column-pipe."

Of course, pumps were built on the differential principle prior to the invention of Riedler's controlled valves, but Messrs. Fraser and Chalmers appear to make a specialty of this type of pump, in connection with the Riedler system, in single, double, and triple form. Pumps are also built on the double-acting principle (preferably on the duplex pattern), and driven by compound engines of either the ordinary slide-valve or Corliss type.

The following table (compiled from information supplied by Messrs. Fraser and Chalmers) gives some particulars as to the capacities, height of column, and piston-speed of Riedler pumps of large size at work in various parts of the world:—

Country or State.	Capacity in Gallons per Hour.	Height of Column in Feet.	Piston-speed in Feet per Minute.
Austria	42,000	900	280
"	48,000	1,500	400
Germany	180,000	900	606
"	33,000	2,480	533
Spain	36,000	1,000	426
South Africa	172,000	110	450
"	14,400	1,520	480
"	10,620	2,000	250
"	17,000	2,000	533
China	25,800	400	310
Alaska	181,000	792	504
California	24,000	1,945	400
Hawaii	500,000	755	500
"	500,000	270	576
Mexico	700,000	53	450
"	41,650	1,654	420