This form of power has been used for some time, and, so far as the writer has record, with good satisfaction in all cases. Gas produced in this way may be used in various types of internal-combustion engines with slight modification. A plant of this kind can be installed at reasonable first cost, is self-contained in so far as the power is generated directly next to the engine itself, and operates at a remarkably low cost upon a relatively inexpensive form of coal. The plant takes up more room than some of the other types, and calls for a larger pumping-station space.

Fuel-Oil Engines—In the writer's experience, in nine cases out of ten fuel-oil engines have proved an ideal installation for plants from 25 to 150 h.p., and for this reason it may be proper to give some extra details regarding this engine. The term "fuel-oil" is here used to mean any oil, from the heavier crude petroleum up to kerosene.

Fuel-oil engines are to-day known under two general heads as Diesel and Semi-Diesel, or surface ignition.

Semi-Diesel Engines

The idea conceived by Diesel is the bringing into compression a mixture of air and oil vapor to a point where heat is generated sufficient to ignite the combination. The compression reached varies from 500 to 1,100 lbs. per sq. in., but when the proper temperature occurs the gases burn rather than explode, and it is the claim of the producers of the Diesel type that this slower burning conserves the power of the gases, and the energy realized is utilized almost entirely in pushing the piston through the length of its stroke. In order to permit of the great pressure produced by this process, the machine must be exceedingly heavy, and the great amount of work which is required to perfect the Diesel engine makes it too expensive for the ordinary requirements of small water-supply plants.

The Semi-Diesel, or surface-ignition engine, on the other hand, gets its power by the explosion of a mixture of air and oil gas in the cylinder under compression around 200 to 300 lbs. per sq. in. While part of the energy is undoubtedly used in the shock against the metal of the plunger and cylinder, the resulting thrust produces motion of the piston, which is connected through the crosshead, or directly to a crank shaft which gives the motion to the driving pulley or gear.

The Semi-Diesel seems to meet all the ordinary requirements of the ideal engine described above, and while the first cost of this engine is considerably greater than that of the gasoline engine or the electric motor, the operating costs are so low that this outweighs in most cases the advantages of the low first cost of the other machines.

Poor Fuel Oils Satisfactory

In the types which are considered as small pumping outfits, designed to pump the water for communities of from 1,000 to 10,000 inhabitants, the engines required ranged from 25 to 150 h.p., but in the writer's opinion there is a large field for a still larger oil engine, and there are some machines now being produced that show wonderful efficiency in operation. They are of the Semi-Diesel type, but are able to operate on the poorest grade of fuel oil, and even tar products which have to be heated before it is possible to get them into the cylinders. The oil used runs as low as 18 degs. Beaumé, while in the smaller machines—that is, below 60 h.p.—the writer knows of good results with oil heavier than 26 degs. Beaumé, and with 25 to 35 h.p. engines kerosene or light oils of that grade have seemed to give the most satisfactory results. Pre-war prices ranged from 2 cents to 7 cents for the various grades.

The ordinary time of starting with fuel oil is from 12 to 18 min., but engines of this type may be equipped with apparatus which permits of instant starting by electric ignition and gasoline, the fuel oil being turned on after a few minutes, without interruption of the operation of the engine. This latter contrivance is of especial value where but little storage of water is possible and pumps have to be operated in case of fire, as the delay in heating the cylinder head may be serious if the supply of water is not available.

It is claimed by the advocates of the electric motor, in comparison, that the motor requires little attendance, while the oil engine calls for constant supervision. This claim is not entirely substantiated in practice, for many of the oil plants are operating for long periods of time without attendance. This of course assumes that there are duplicate units which will take care of any fire hazard if repairs are necessary. It should also be considered that constant attendance does not eliminate many of the breakdowns.

Perhaps the most satisfactory combination that can be installed for a small pumping plant for general municipal needs is made up of two duplicate units, of which it is probable that the fuel-oil engine meets the needs fully as well as any other drive which has been developed up to this time.

One advantage, of considerable importance in some cases, that steam machines have over most of the other types is in the varying of speed in operation. The speed in the electric motor and of the internal-combustion engines is variable only to a small extent, except by change gears or belt pulleys, and it is sometimes necessary to pump to waste or through a bypass back into the suction, an uneconomical process, in order to keep the rate of delivery as desired.

Comparison of Costs

The writer had occasion, a short time ago, to make a comparison of different types of pumping plants, to determine which plant would best meet the needs of a community. In connection with this, the results of investigation of different units were tabulated and are given on page 289. The figures are not to be considered as exact, either of operation or first cost, but are obtained by using quotations and guaranteed efficiencies by the manufacturers of the different lines of machinery. These figures were also taken before the extreme rise of prices which occurred since the United States entered the war, and, while they are far above the averages of five years ago, it is probable that they are nearer what we may expect in the next few years than pre-war prices.

WILLIAM ARMSTRONG RETURNS TO CANADA

William Armstrong, who was formerly Canadian representative for a number of English manufacturers, has returned to Canada after four years of war work, and is again acting as Canadian agent for several prominent overseas firms. When war was declared, Mr. Armstrong happened to be in Vancouver. He left for New York and sailed for England, where he enlisted as a lieutenant in the admiralty, and was assigned to engineering duties on board one of the warships. Shortly afterwards, however, he was appointed technical officer in charge of mine production, and when the armistice was declared he held the rank of acting-commander. Under Mr. Armstrong's direction approximately 3,500,000 mines were manufactured, largely by electric welding.

The agencies which Mr. Armstrong has undertaken are as follows:—

Quasi-Arc Electric Welding Co., covered electrodes and resistances for use in electric welding; Sturgeon Centrifuge Co., centrifuges of various types for clay drying, sewage disposal, etc.; Hick, Hargreaves and Co., condensers, Diesel engines and steam engines; Jos. Booth Bros., Ltd., electric overhead travelling cranes; T. F. Braime and Co., seamless specialities in all metals; Yeadon, Son and Co., briquetting machinery; Head, Wrightson, Ltd., colliery apparatus and blast furnace plant; Sankey and Son, Ltd., steel wheels for automobiles; British Electric Vehicles Co., electric trucks for conveying baggage at railway terminals, handling shipments from warehouses, etc.; Jos. Carter (Stalybridge), Ltd., rubber-working machinery.

The president of the Draftsmen's Association, which has been organized in Toronto, is Geo. H. Rix, of the C.N.R. staff. The secretary is Arthur E. Fetherstonhaugh, architect, 234 Kingswood Rd., Toronto. Meetings will be held the second and fourth Fridays of each month during the fall and winter.