and distance pieces, and are tied by a continuous cross stay above the four main bearings.

The valve gear is of very substantial design of the double bar, link motion type, all wearing surfaces being large and adjustable. The eccentric rods are of wrought iron, with T end for attaching to straps, and fitted at link ends with cast steel forks and adjustable brasses. These rods are comparatively short, and the valve spindles are correspondingly long, thus making the parts to be moved by the reversing lever lighter, and facilitating the handling of the engine. The reversing lever is 7 feet long, stands 5 feet above the starting platform, and has a travel from "full ahead" to "full astern" of 4 feet 6 inches. The quadrant with the lever for operating the throttle and injection valves, is fastened to one of the main frames at a convenient distance from the reversing lever.

The condensing apparatus is placed below the L.P. engine, resting on the ship's floors. The air pump is vertical, single-acting, fitted with bucket and delivery valves, and connected to the jet condenser by a channel plate, in which is located the foot valve. From the ends of the air pump crosshead, the feed and bilge pumps are driven, the whole of the pumps being operated through wrought-iron levers and drag links from the crosshead end of L.P. connecting-rod. A bilge injection valve is fitted so that, when necessary, the bilges may be pumped out by the main engines through the air pump. The valves of all the pumps are arranged so as to be easily accessible.

The paddle-wheels are radial, 14 feet effective diameter, each wheel having 14 floats 4 feet 6 inches wide.

Steam is supplied by two steel boilers 54 inches diameter by 20 feet long, of the locomotive type, placed forward of the engines. They are built for a working pressure of 130 lbs. per sq. inch.

The estimated horse-power of the engines, at 40 revolutions per minute, is 300.

For THE CANADIAN ENGINEER.

SEWAGE DISPOSAL.

BY WILLIAM M. WATSON.

In previous articles on sewage disposal the writer described the International Purification System, which uses ferrozone for a precipitant and polarite for a filtrate. Compositions of the ferrozone and polarite used were also explained, and he commented on the cost and efficiency of the system. The Rivers Purification Company's system was taken up, which purifies sewage by carbonized refuse, such as vegetable garbage, excrements, etc., collected in towns, brought to a red heat in a muffled kiln and afterwards used to filter and purify the town's sewage. There was also a detailed description of the workings of the Bradford, Eng., sewage works, where a precipitant of milk of lime was used. The Amines system of using a mixture of herring brine and lime, the Conders process of using a solution of lime, and the native guano process were dealt with. All of these can be studied in the back numbers of THE CANADIAN ENGINEER.

I then stated that purification by land was impossible on account of the extreme climatic influences in this country, and even in a very mild climate such as New Zealand the land is often unsuitable Irrigation lands should be gritty and porous to a depth, at least, of four feet, and should be well and carefully under-drained. It was formerly supposed that vegetation was the principal factor in the cleaning and purifying process. In summer, vegetation will extract the manurial constituents, and powerfully assist in destroying the bacteria. But careful experiments prove that farm land is really a process of filtering, and that the purification is effected by oxidation. Therefore, irrigation lands must have periods of rest to allow time to secure aeration, and should never be drowned or water-logged; and to prevent it doing so, provision should be made to store the sewage during storms or severe frosts. By having separate drains for the carriage of sewage the flooding can be avoided, but I see little chance of providing for long periods of frost except by going to the unreasonable expense of covering the irrigation land in winter.

If the land is composed of adhesive loam, light loam, or light gravelly soil, the whole of the organic matter contained in the sewage can be removed. The underdrains should be in short lengths, close together, say every two feet, and the discharge end terminate in an open channel, so that air could freely pass through them to the land. Nearly all public authorities owning irrigation works consider that an untrained farm laborer is able to manage the works, the result being that, say, the $100,000 spent in shaking up the land and underdraining is lost, because the land gets fat and useless, the drains are choked, and the sewage passes through untreated.

Broad irrigation is effected by running the sewage direct on to farm lands, and on account of the tenacity of soil in holding in suspense moisture, sufficient land must be acquired to allow one square yard to each two gallons of sewage discharged per day in dry weather. The land would sometimes absorb a great deal more, but it requires to have periods of rest sometimes for as much as a month, and it is unsafe to allow an average of more than two gallons per yard per day. The amount could be increased by doing some draining to draw off the moisture. The land on the slope of a hill is the most suitable; low, flat land that is often waterlogged is useless. In most places it will necessitate pumping the sewage to the hill top. There is no fixed rule how to proceed in distributing the sewage on the land. Generally shallow channels are cut by a spade, and the sewage drawn from the nearest branch. Broad irrigation on farm lands is feasible where the city is built on a hill and there is plenty of arable land that is situated below the level of the main outlet of the sewer, and the land itself is high and dry above the storm water mark of the nearest water course. But except the town is fortunate enough to have these requirements, the system, if adopted, is expensive, and can only answer for a makeshift, useful in dry weather.

The Government in Great Britain for the past fifty years has demanded that all sewage shall pass through land during the final filtering stage. It happens that the majority of large towns are built in hollows and low lands bordering on the water courses, and on the banks of navigable rivers or seas, and only high enough to secure a good fall for the drains above the high water mark, and they cannot possibly introduce a simple inexpensive gravitation sewage works; but where six feet in depth can be secured it can be accomplished, by the screening bank and roughing filter being on the same level, then letting the clarified sewage come from the top of the roughing tank on to the land, thus doing without any machinery or sludge presses. Twenty feet is about the depth necessary to provide for the proper arrangement of a good self-acting works; it then gives space for mixing the precipitants by water power, and of shaking up the sewage water by water wheel or turbine, and the first or roughing filter can work downward, the clarified sewage passing out at the bottom of the tank and over a water wheel or rough stones to give it another shake up, and aerate it, then run along box-made channels on to the bacteria filter, composed of