Pumping, Piping and Heating

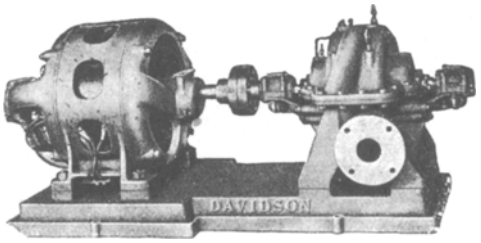
A Discussion of Equipment and Process Methods for the Average Fatty Oil Plant

By THOMAS ANDREWS

PIPE lines and pumps move our oil about to the destined points with a minimum of trouble and one of the most striking points of a big oilworks, running a large number of processes, is the number of and the varied types of pipelines that are encountered. To the casual visitor these pipelines are "just pipelines" and probably he never realizes that each has its own peculiar use which has to receive the careful attention of the designer and the maintenance engineer. In oil process work, the pipes may be made of any of the following materials each of which is indicated in special positions—steel, wrought iron, cast iron, lead, copper, brass, vitreous ware, and special alloys made to resist the action of some of the reagents used. Apart from the fact that it is often necessary to choose a special material for the pipes, it is often necessary to joint the pipes in some special manner and consequently, we have joints made by screwing, flanging, welding and brazing. Moreover there are plain pipes, lagged pipes, coil wrapped pipes and jacketed pipes—altogether a rather formidable list.

Through these pipes we pass oils, fats, fatty acids, glycerin, alkaline solutions, acid solutions, and solutions of the various salts in use some of which would soon destroy the metal if no care were exercised in its choice. Apart from these special process pipes there are, of course, the common works' pipes of which the steam, superheated steam, gas, water gas, ammonia, hydrogen, carbon dioxide, and water pipes are the most important. The greater part of the oils pass through ordinary screwed and socketed piping and, provided that it is properly supported, free to expand and not subject to shock, such as is introduced by heavy intermittent pumping or by a large number of sharp bends, it is surprising how little attention it requires. The loss of oil on a well erected screwed pipeline is practically nothing but even so it is surprising to find how often, through carelessness, there is a small drip of oil exuding from screwed joints. The money side of the loss is often trivial but oil has a habit of making a sticky deposit which is difficult to clean up. We often find that it does not get cleaned up with a consequent deterioration in the morale of the works.

Hard fats, the solid fatty acids, and the hydrogenated oils are passed through pipes jacketed for steam or hot water. These are generally made of cast iron, the ports for the jacket being cored through the flanges of the pipes. In erecting these pipes care should be taken that sections can be removed without disturbing the whole run. This often means that pipes of standard length cannot be used and consequently the first cost of the pipes is high. This higher cost often fades into insignificance



Courtesy M. T. Davidson Co.

Motor Driven Centrifugal Pump

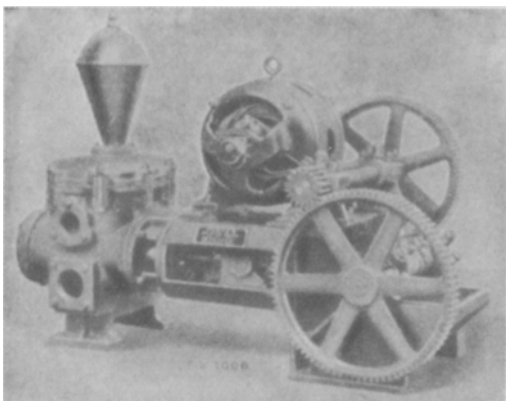
however, when a blockage in the jackets arises or when for any cause the pipes have to be taken down in sections. There are times when cast iron pipes cannot be used and steel pipes can. In these cases, it is not usual to jacket the pipes owing to the high cost. But the steel pipes are wrapped with a small pipe to carry the heating fluid.

Copper pipes of five-eighths inch bore are wrapped around the steel pipes, the steam circulating through the copper tubing. It is necessary to take drain tappings at frequent intervals to prevent water hammer or stoppage through condensation. In non-exposed places and in clean processes a length of ordinary one-half inch iron piping may be laid along the steel pipe and tightly bound to the pipe with a layer of metallic gauze. The whole is encased in lagging and on steam being passed through the small iron pipe, we have the same effect as in the coil wrapped pipe at a much

lower cost. By placing unions on the heating pipes to correspond with the joints in the heated pipes it is a simple matter to arrange to lift out sections without disturbing the whole. This is especially necessary in the case of lagged piping as it is then possible to remove the section without disturbing the lagging. High pressure steam, superheated steam, and high pressure gases are usually carried in welded steel piping:—alkaline solutions, salt solutions and water are carried in cast iron piping. Care must be taken in arranging these pipes to see that where they are used to carry hot solutions that are liable to deposit crystals on cooling there is a drain pipe fixed at the lowest point in the service to remove any solution left in the main and to see that there is a steam or air service fixed at the highest point so that any of the hot liquor lying in pockets can be blown out before it has time to crystallize. Acids are usually carried in lead pipes although where the lead salts are soluble some alloy must be used unless recourse be made to the use of vitreous ware. Brass pipes find their chief use in the condensers and to a less extent in the heating systems. Copper is used in the small mains, sometimes in the steam mains.

Pumps and Pumping

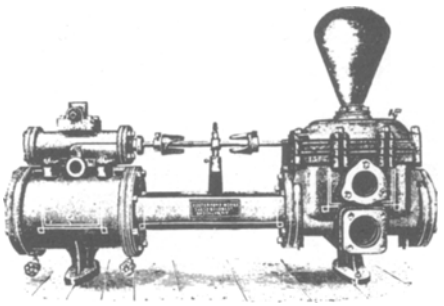
IF WE liken the pipelines to the veins of the oil body then we may refer to the pump system as the heart of the oil body as without the pumps, the greater part of our pipelines



Courtesy Foster Pump Works

Motor Driven Duplex Pump

would be dead. The oil world abounds in pumps that have been designed to carry out many different jobs in pumping. Apart from the hydraulic pumps, we find feed, general purpose, positive rotary, centrifugal, semi-rotary, ejector, vacuum pumps and air compressors doing various work in the oil industry. These pumps may be steam, belt or chain driven or may be direct coupled to electric motors. They are made in a vast number of ways and of most materials. Not only do they pump the



Courtesy Foster Pump Works

Simplex Steam Pump

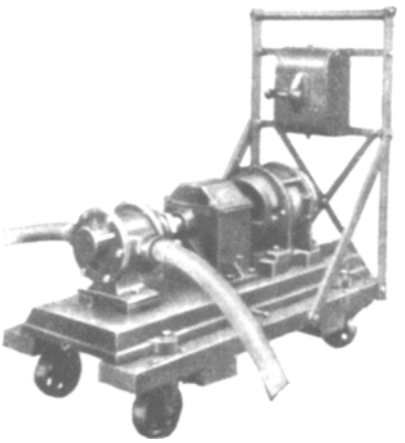
oils but they circulate the water, agitate the oil, feed the boilers and the filter presses, pump alkali and acid liquors, exhaust the various vessels, boost the gases, compress air, hydrogen, and the refrigerating gases and even fire our boilers.

For the general pumping of oil, the type of piston pump known as the general service pump is largely adopted. With this type of pump the so-called "hydraulic end" can be larger in diameter than the steam end, the proportion being inversely as the total pressure on unit area of the two ends less a factor for losses. The average low pressure piston pump has very little of the steam stroke working expansively and therefore the steam efficiency is very low It is very necessary, therefore, that we should make as much use as we can of the available pressure by increasing the area of the hydraulic end of the pump to its limit.

Centrifugal pumps, either belt driven or electric coupled, offer a good alternative to piston pumps when large quantities of oil, water or other liquid have to be moved and, provided that the suction side is free from air leaks, a good centrifugal pump more than holds its own with other types of pump when the quantity to be pumped is large. The great use of the centrifugal pump in oil works is to circulate the vast quantities of water that are used for cooling purposes. In picking this water out of the hot wells, circulating it over cooling towers and pumping it back into the mains, the centrifugal pump has no equal. If it were possible to standardize the pumps in an oilworks, I should certainly give priority to the positive rotary pump. These pumps are

made in all classes of metals and can be made to handle liquids of all viscosities. They are, moreover, designed to work at all pressures up to 500 lbs. per square inch and being without valves and with few moving parts they give very little trouble and their life is quite good.

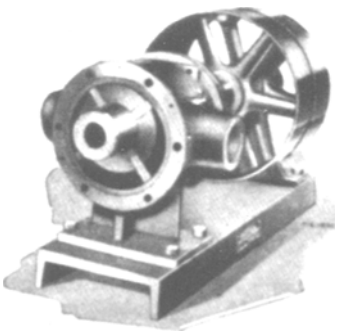
I have used them, working with a variable speed gear, even for filter press work and for handling large quantities of oil for filtering



Courtesy Foster Pump Works

Portable Motor Driven Rotary Pump

they are very good. They are able to handle such materials as warm soap, caustic solutions, acid solutions, water glass solutions, resin

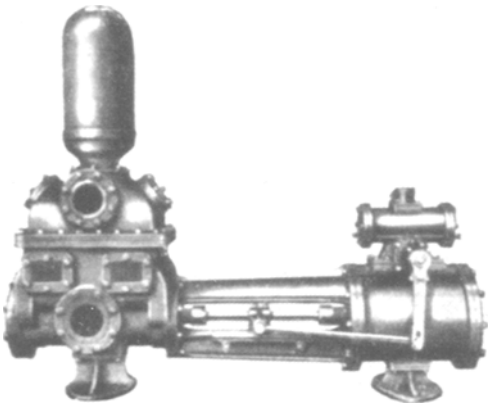


Courtesy Foster Pump Works

Rotary Pump—Head Removed

soaps, glycerin, molasses, oil, water, benzene, and the other solvents used in extraction work. I have used them jacketed for pumping high melting point waxes and on one occasion I used one as a wet vacuum pump and from this temporary rig-up I should think that they could be designed to do this work admirably.

Ejector pumps, by which I mean those pumps which induce a velocity in a fluid through the medium of a velocity in another fluid, are used chiefly for air agitation. They give very little trouble if kept clean and are able to move large quantities of air. Their easy manipulation and the fact that they need no gearing causes their adoption in a large number of cases where accessibility is bad and where space is limited. The field for the vacu-



Courtesy M. T. Davidson Co.

Heavy Duty Boiler-feed Pump

um pump in oil works is a large one. All types are met with varying from the dry pump capable of holding a vacuum within .02″ of the barometer to the wet pump, possibly dealing with a much larger quantity of fluids, but holding a vacuum of only about 26″ or only within 4″ of the true barometer. Such processes as deodorizing, glycerin evaporating, glycerin distilling, fatty acid distilling, oil drying, and caustic soda concentrating all call for the right type of vacuum pump with the right capacity if the product is to be produced of the highest quality and at the right price.

The type of drive that we employ is immaterial provided that it is economical. Steam drive to our pumps is the best where large variations of speed are desirable and where the pressures are subject to large variations: belt or chain drive where the speed and the pressures are constant but the working is intermittent: electricity where the load is steady and long periods without breaks have to be catered for.

There is another system of moving liquors that is in use in oil-works and that is the "montejus" or pneumatic system. Its use entails a system of enclosed vessels into which

(*Turn to Page* 41)

Pumping, Piping and Heating

(*from Page* 17)

the liquids are fed. Air at a pressure consistent with the work to be done is forced on the surface of the liquid. This pressure is imparted to the liquid and on the opening of an outlet forces the oil to its destination. The great advantage of this system is the great evenness of the pressure. In small installations, it has the great disadvantage that there is left at the end of a run a vessel full of high pressure air which cannot be used. In large installations, the high pressure can be alternatively transferred from one vessel to another and there is not the same loss.

Valves and Stopcocks

THE control of our processes is largely dependent on satisfactory cocks and valves and in a large works there is an assortment ranging from the tiny 1/16″ "pilot light" cock on the gas plant to the 20″ sluice valve whose weight runs into many hundreds of pounds. They must all, however, have one characteristic in common and that is they must be absolutely positive in action. I have seen, in oil works, in positions where the conditions were very trying, two valves or cocks placed on important mains with a small drain cock placed between them so that when the main was shut off any leakage from the first cock was side-tracked through the drain leaving the second cock to isolate the main at atmospheric pressure only. This I submit as bad. I am quite aware that there are conditions of control that are very difficult but I have yet to meet one where it has been impossible to get the right cock or valve for a specific task.

Undoubtedly the most difficult positions are those where gases at high pressures and temperatures mixed with fluids under the same conditions have to be isolated. Such a case occurs in hydrogenating oils where that most elusive of gases, hydrogen, is circulated at pressures up to 150 lbs. per square inch and with temperatures up to 220°C., in conjunction with oil at the same temperature and pressure. Add to these the scoring action caused by the diatomaceous earths circulating with them and you will have as pretty a problem for solution as any engineer will wish. The cocks and valves suffer the same conditions as the pipe lines they control and have to be chosen in conjunction with them. Thus we find cocks and valves made from the same variety of materials as the pipes and so made to stand those conditions we have already discussed under the subject matter of the pipes.

Process Vessels

THE process being carried out will determine the nature and material to be used for the various process vessels and these are not the same that govern the pipes and fittings connected to the vessels. As an example, wrought iron pipes are generally ruled out on caustic mains but soap pans—using the caustic brought by them—may be, and are, made of wrought iron plate. The same ruling holds good wherever chemical action takes place in a pan. A new series of conditions arise which are governed by the product which will be made in a pan and the excess of one reagent over another. The dilution of this excess has also to be taken into account. These rules are fairly obvious but it is no unusual happening to find plants designed rather from the point of view of the action of one reagent than from a survey of the whole position. Designers often differ in their choice of metals for the plant in any particular process but mild steel is the most useful metal for oil plant work and is used in the bulk of the plant: copper has a limited application: lead is used where acid liquors are used in excess: tin is used as a lining in some better class edible oil plants: nickel is sometimes used in our varnish works: Dural has been patented for high temperature deodorization owing to its limited action as an agent of hydrolysis: silver is used for edible fermentation processes to a small extent: while wood in the form of vats of various shapes forms a goodly proportion of the plant on the fatty acid side. Various alloys of the rare metals find uses in the small fittings while stainless steels and Monel metal are coming into rapidly expanding use.

Heating Devices

THE majority of our vessels are fitted with some form of heating device. These vary considerably in type as vessels may be jacketed, fitted with coils or with tubes or may have the temperature of their contents raised by means of an external heater when the heating medium is a fluid. They may also be heated by the ordinary fire, by gas or by oil furnaces or by electricity. The fluid in the jackets, tubes or coils may be either hot water, saturated steam, superheated steam, superheated water, or heated oil. With water heating whether at high or low pressure (i. e. superheated water in the case of high pressure water), no heat is used in converting the water into steam and, where the water is circulating