PAGES

MISSING

THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING

COURT ROOM No. 2, TEMPLE BUILDING, TORONTO,
May 28th, 1912.

The first Vice-President, Mr. A. Taylor, occupied the chair.

Chairman,—

We have now been waiting quite a while for our President, but I understand he is sick; in fact, he has been sick for some time, and we all hope that he will soon be able to get around all right again.

The first order of business is reading of minutes of previous meeting.

As you have all had a copy of the minutes of the previous meeting sent you, and have, no doubt, derived much pleasure from reading them, it will be in order for some one to move that they be adopted as read.

Moved by Mr. Baldwin seconded by Mr. Wright that the minutes of the previous meeting be adopted as read. Carried.

Chairman,—

We shall all be very pleased to hear from Mr. Wickens in reference to the arrangements that have been made regarding the Annual Outing.

Mr. Wickens,—

I might say that we have made arrangements with the Canadian Pacific Railway to take us to Erin on June 22nd. We have not yet settled on the time of starting or the time we shall leave. This has been left over so that the Committees may have an opportunity of discussing the best time to leave and return.

It will now be necessary for some of the members of the Committee to go to Erin and make arrangements about the park for the games and for the meals, so that the Secretary can go ahead and get the invitation cards out.

We have got a good rate from the Railway Company and I think it will be necessary to sell the tickets for $1.25.

I have made enquiries about the town and I understand that it is a very pleasant little place, and the grounds are in good condition and will be excellent for holding our sports, etc. There are two nice country hotels at which we shall be able to obtain meals, which will do away with the necessity of all being crowded into one small place as we have done previously. The journey to Erin is through very interesting and pleasant country, and I think the whole trip should be very pleasant.

Chairman,—

The Executive and Reception Committee will meet after this meeting to discuss this matter.

We all know Jackson's Point and Beaverton, and while the grounds are very nice, they are not as nice as they might be, and we have not been able to carry out our sports as successfully as we would like to do.

The next order of business is the announcement of new members.

New Members.

J. Adam, Electrician, Toronto.
J. Lindsay, Storekeeper, Gurney Foundry Co., Toronto.
J. D. Frazee, Agent, Toronto.

Secretary,—

I might say gentlemen for the last two or three months we have only had two or three new members at each meeting, and as there is hardly a month goes by but we have three or four drop out through leaving the city, etc., it is necessary that members look around and see if they cannot bring in a few new members.

Members Present.

A. M. Wickens	Jas. Wright	G. H. Varles
J. H. Williams	J. Kelley	C. G. Herring
C. H. Stainton	J. Adams	W. Newman
G. D. Bly	T. B. Cole	W. Dennett
L. H. Rumage	J. Jackson	E. Blackstone
J. Herriot	G. Baldwin	W. Maybank
A. W. Carmichael	G. H. Boyd	B. Riordan
D. Chapelle	A. G. David	W. David
T. J. Ward	G. Kyle	D. A. Dixon
L. Salter	J. W. Walker	G. A. Young
G. MacKenzie	J. M. Clement	W. Fish
J. Barker	A. W. Davis	D. Campbell
R. Fish	A. C. Pratt	G. Cooper
W. Evans	E. Logan	W. C. Sealy
J. Reid	T. McKenzie	L. S. Hyde
C. L. Worth		

Chairman,—

I will now pass on to the order of business, "Reading of papers and discussion thereof."

We have with us to-night Mr. A. C. Pratt, who will read us a paper on Lubrication, and I have no doubt the paper will prove very interesting as we shall all be glad to hear the fine points of lubrication as we are all anxious to know how to cut down the cost of oil and I have no doubt that Mr. Pratt will be able to help some of us considerably before he gets through with his paper.

Mr. Pratt,—

I may say that there has been very little written on this subject. I am indebted to Mr. J. W. Peterson, of New York, for some of my statistics, the rest is from my personal experience.

LUBRICATION.

The lost power caused by friction (the resistance caused by the motion of a body when in contact with another body which does not partake of its motion) in steam and gas engines and other auxiliary power plant machinery, is from 3 to 24 per cent. As this loss goes on from one day's end to the other, and we have nothing to show for it but increased fuel bills, the selection and application of proper lubricating oils is one of the most important problems that an engineer has to deal with.

Lubrication is the application of a fluid oil between two rubbing surfaces which will tend to keep them apart. A film of oil flowing between the bearings fills up the irregular places, and keeps the surfaces apart and also carries off any heat generated which would otherwise be absorbed by the bearing surfaces. To accomplish these desirable results the lubricating medium should have certain essential qualities and be properly applied, which the writer will herein discuss in a brief manner and eliminate so far as is possible lengthy technical explanations.

There are an infinite number of different kinds of oils and lubricants on the market which are offered by the manufacturers for general power plant lubrication. These are mostly all compounded from vegetable, animal, or mineral oils, and in some cases in combination with about 5 per cent. by weight of graphite. Vegetable oils are very seldom used alone, as they possess low lubricating properties and also have a tendency to decompose at comparatively low temperatures and become thick and gummy. Animal oils have a somewhat higher lubricating value than vegetable oils, and are used to some extent in compounding with mineral oils, but are very seldom used alone, as they have a tendency to decompose in the presence of heat, liberating acids which attack metal and cause pitting, etc. For bearing lubrication, mineral oils which are compounded with animal fats frequently cause serious trouble where the oil is to be filtered and used over again, on account of its emulsifying (mixing) with entrained water, collected with the oil (condensation drips from piston rods, stuffing boxes, etc). This mixture is hard to separate, therefore a high grade of mineral oil that can be easily filtered and separated is best suited for automatic bearing lubrication.

By far the greater proportion of modern lubricants are made up of mineral oils which are products of crude petroleum and can be had in a wide variety, running anywhere from the lighter grades of sewing machine and typewriter oils up to the heaviest grades of grease.

Some of the qualifications of the good oils are as follows:—

1. Sufficient body to keep the rubbing surfaces separated by a thin film of oil.

2. Maximum fluidity or ability to flow, consistent with the body required.

3. Low co-efficient of friction and ability to carry away heat.

4. Freedom from corrosive acid and any tendency to oxidize, gum or decompose.

5. A high flash point or temperature of vaporization and a low freezing point.

Some of the methods used by engineers in specifying oils are by their specific gravity, viscosity, flash point, burning point, cold test, acidity, and friction test.

The SPECIFIC GRAVITY or density of an oil is the ratio by weight of a given quantity of an oil as compared with the same volume of water. This is usually determined by a hydrometer, or in the oil trade is usually designed by a special scale known as Beaume. The relation of the specific gravity to the Beaume scale is given by the following expression:

$$\text{Specific Gravity} - \frac{140}{130 + \text{degrees Beaume}}$$

The densities of different kinds of oils are about as follows:—

Water	10	deg. Beaume.
Cylinder oil	24.5	deg. Beaume.
Heavy engine oil	25.5	deg. Beaume.
Light engine oil	27	deg. Beaume.

A simple and accurate method of determining the specific gravity of oil is as follows: Take a clean bottle and weigh it. Then fill the bottle with water and weigh it again to find out the net weight of water it will contain. Empty again and fill to the same point with the oil to be tested. Then ascertain the net weight of the oil. The weight of the oil divided by the weight of the water gives the specific gravity of the oil.

VISCOSITY is the measure of the fluidity or body of an oil and is usually taken as the time for a given quality of oil to run through a standard orifice. These tests are usually made in a viscosimeter. As these instruments have different sized orifices the specific viscosity is often taken, which is the ratio of the time for the oil to run out to that of an equal quantity of water at 60 degrees. The viscosity of engine oil is usually rated at 70 deg. F., and of cylinder 212 deg.

THE FLASH POINT is determined by slowly heating a given sample of the oil in an open cup and noting the temperature at which a spark applied to the vapor will ignite it. As the effect of heat on oil is always to lessen its body, therefore decreasing its ability to keep two rubbing surfaces separated, flash test is of considerable importance.

The standards usually used for flash test are as follows:—

High pressure cylinder oil	600 deg.	610 deg.
General cylinder oil	550 deg.	585 deg.
Heavy engine oil	400 deg.	
Refrigerating oils		300 deg.
Gas engine cylinder oil		500 deg.

The fire test can be made if the heating be continued till the surface of the oil ignites and continues to burn. The temperature at which it ignites is the burning point, and will be found to be 45 to 75 degrees higher than the flash test.

THE COLD TEST is the temperature at which the oil will just flow. This is usually taken at 30 deg., except in the case of refrigerating oils, in which the figure is 0 deg.

A simple test for determining whether an oil is compounded with animal fat can be made as follows:—

Pour a small quantity of oil into a bottle with about an equal amount of water and a teaspoonful of borax. Shake these well together, and if any animal fats are present it will form an emulsion, but if the oil is a pure mineral product it will readily separate from the mixture and rise to the top of the water.

One of the easiest tests to make for acidity is to take a small sample of oil and place it in a test tube with a little copper oxide and subject to a gentle heat for three or four hours. If fatty acid is present the solution will turn green, and if vegetable acid is present, it will turn blue.

The foregoing remarks indicate that it is well for the engineer to be familiar with these simple tests in selecting the proper kind of oil, whether for cylinder or bearing lubrication, for unless a good grade of oil is used, proper lubrica tion cannot be accomplished.

The usual facilities of an engine room do not offer means to make elaborate tests, but an engineer can often make comparisons of different kinds of oil, as for instance: A difference between two oils can be easily determined in the temperature of the bearings on a machine, by placing a thermometer in the bearing, or emersed in the oil reservoir.

Any engineer can easily determine the lubricating value of different kinds of cylinder oil by trying out several samples under the local conditions existing in his plant. An engine will indicate lack of proper lubrication, either by a slight groaning or trembling of the valves or vibration of the eccentric rods, or in some kinds of engines a rattling noise in the steam chest, etc. By applying the different samples and feeding a certain number of drops per minute, which can be gradually reduced until the proper amount for good lubrication has been determined, the several samples can be tested and the one best suited for the work can be chosen.

The principal essentials of a high grade cylinder oil is found in the heavier and viscid of mineral oils, but on account of the inability of pure mineral oils to adhere to wet surfaces, it is necessary that they be compounded with animal oils. Some moisture is always present in the cylinders and valve chambers of steam machines, which is due to condensation of steam on its way from the boilers, and also to expansion in the cylinders.

A pure mineral oil which may have proper viscosity and flash test will not emulsify (mix) with water, and, therefore, will not adhere to these moist surfaces, but will be washed away with the action of the steam in passing through the valves and cylinder. If mineral oil be compounded in a proper proportion with animal oil it will freely emulsify with the moisture on the cylinders and valve chambers and adhere to same, which is absolutely necessary to insure good lubrication.

Every engineer who desires to reduce friction losses and oil consumption should make a study of his particular plant and bear in mind that friction costs more than oil, or appliances to apply it. From the writer's experience in general power plant lubrication more study is generally devoted to the selection of lubricating oils than to the number of their lubrication, and while it is admitted that one of the first essentials to good lubrication is the selection of a proper grade of oil, don't think that this solves your lubricating problems. The way the oil is applied is of equal, if not greater importance, than its quality.

Of course, we appreciate the fact that some people think the question of lubrication is a small and unimportant matter. Some time ago the writer talked to the superintendent of a great big cement company. He said, "Yes, I believe that we are wasting oil, a whole lot of it. But if you figure the effect of that loss on a barrel of cement it is a very small item. We have got other things to remedy first." However, he later assured him that when he had taken up these other matters, that he would certainly improve the method of the application of lubricants in the various plants under him.

APPLICATION OF CYLINDER AND MACHINERY OIL TO POWER PLANT MACHINERY.

There are several applications under which power plant lubrication might be divided. First, we will take up general cylinder and bearing lubrication. The chief distinction between these two is that in cylinder lubrication, the oil which is fed to the cylinder finally passes away with the exhaust and is lost. In many plants the question of separating cylinder oil from the exhaust steam is a serious problem on account of the desirability of using the exhaust for heating, drying, etc., or condensing it and using it over again for boiler feed. Therefore, it is highly desirable to apply cylinder oil in such a manner that only the exact quantity is fed to the steam which will thoroughly atomize and enter the cylinders in a fine spray, which reduces to a minimum the amount necessary for good lubrication. For bearing lubrication the oil can be collected, filtered and used over and over again until all of its lubricating qualities are exhausted. In many large plants where filtering systems of this kind are in operation, the same oil is used over and over again indefinitely, the only additional oil being necessary is the make up for the small shrinkage caused by evaporation, wear, etc., and any oil taken from the system for hand oiling on valve gears, or such points as it is not practical to lubricate automatically.

CYLINDER LUBRICATION.

Almost within the memory of the youngest engineer, cylinder lubrication has gone through many changes. First was the old coffee pot, kept on the top of the steam chest, and containing suet or tallow, which was injected through a small hole in the cylinder every time the engineer happened to think of it. Next grease cups were used, in which the grease was continually supposd to be reduced to a liquid and flow into the steam chest, lubricating the valves and cylinders, but as the grease was usually cooked out of the cups and went most everywhere except where needed, this system was soon abandoned. Next came the hydrostatic lubricator, in which three or four feet of water pressure was used to inject the oil into the steam, and the last and most important step in this stage was the general adoption of the force feed lubricator, in which the oil is positively and at regular intervals forced by means of pumps, into the cylinders.

All of the above systems can still be found in operation and it might be said that which one of these systems is used, would almost serve as an index to the progressiveness of the plant.

These changes represent a continual endeavor to improve cylinder lubrication, and at the present time the "Force Feed Lubricator" is universally recognized by the engineering fraternity as being the only reliable and efficient system of cylinder lubrication.

The engine indicator has become so universal that engineers now more fully realize the amount of power wasted by the friction of piston rings, steam valves, bearings, etc., and as has been pointed out by authorities on this subject, besides the cost of power wasted, we must also charge to improper lubrication, wear and tear on moving parts which cause scoring and pitting of cylinders, and also the cost of replacing parts destroyed, either by direct strain or gradual wear. All of this must, of course, be balanced against the cost of lubrication.

As above stated, most modern plants now employ the Force Feed Lubricator for cylinder lubrication, each lubricator being equipped with a number of feeds to take care of the different points of the machine to be lubricated. For instance:

Fig. 1 shows mechanical lubricator attached to the cylinder of a Corliss engine. This lubricator has four feeds, one feeds oil into the steam about the throttle valve, two feeds provide lubrication for the two steam inlet valves, and the fourth lubricates the metallic packing on the piston rod. This type of lubricator consists of a reservoir and a series of pump plungers inside of the lubricator, which force the oil to the different points to be lubricated, in unison with the stroke of the engine. It is also designed that no matter at what rate the oil is being fed through the drip nozzles, the various drops are divided into small particles and oil is fed into the cylinders for every stroke of the engine. This cannot be accomplished with the common hydrostatic lubricator —for suppose one of the lubricators is feeding four drops

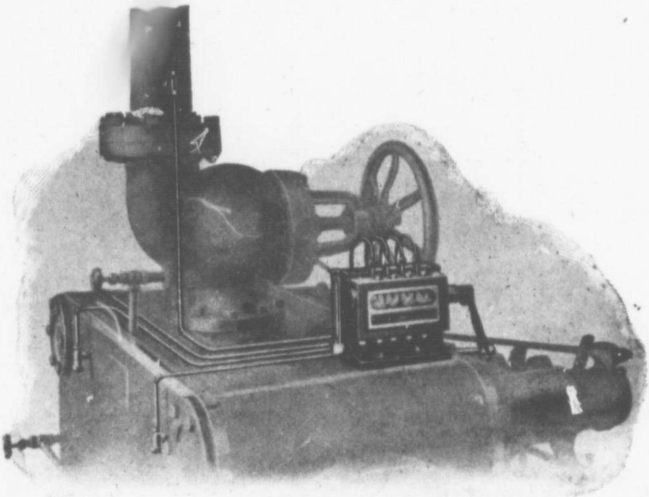

FIG. 1

of oil per minute to an engine that is running 200 R.P.M., it will be seen that one of these drops of oil will be mixed with one cylinder full of steam, fully lubricating one stroke of the engine, and then pass with the exhaust, but before another drop of oil reaches the cylinder, about fifty strokes will be made, entirely without lubrication. The disadvantages of this uneconomical application of oil are apparent and clearly show the reason why Force Feed Lubrication has now been almost universally adopted in all plants where exacting service is required and the science of economy is brought down to a fine point.

In some large plants where several lubricators are used, they are arranged on a modification of the Central Oiling System in Fig. 2.

Here it will be seen three lubricators are supplied by oil from a central overhead reservoir from which the oil flows to the lubricators by gravity—the level of oil in each lubricator tank being maintained by a float valve. Any number of lubricators can be kept automatically filled with oil from the Central Supply System.

While most modern power plants have adopted Force Feed

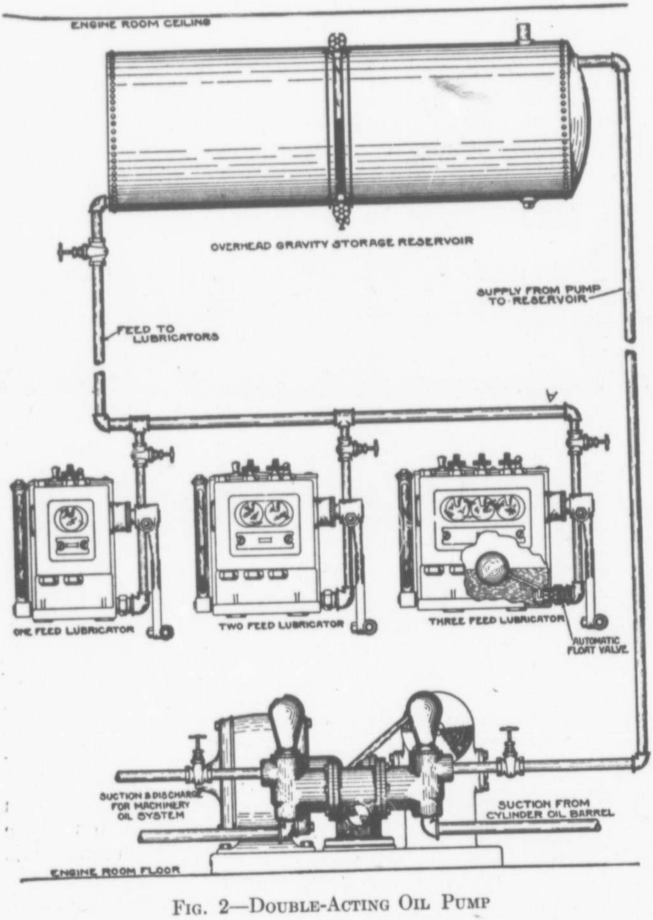

FIG. 2—DOUBLE-ACTING OIL PUMP

Lubrication for the main units, there are, however, many who are depending upon some of the more or less antiquated methods of cylinder lubrication (as mentioned hereinbefore) for supplying cylinder oil to the auxiliaries. Many engineers do not think that the auxiliaries are of enough importance to warrant the refinement of Force Feed Oilings, but the economical lubrication of auxiliaries such as boiler feed and house pumps, air compressors, elevator and vacuum pumps, etc., is at least of as much importance as the lubrication of the main units. Such auxiliaries are usually located in out-of-the-way places, where they do not receive as much attention as the main units, and, furthermore, a comparison of the amount of power used by the auxiliaries and the main units will show conclusively that, if efficient plant operation is to be arrived at, the economical operation of the auxiliaries must be carefully considered, for instance, take one of the largest railroad power houses in the country, having nine compound generating units of nearly 10,000 H.P. each, the area of the rubbing surfaces of the main units amounts to about 1,507 square feet, while the rubbing surfaces of steam ends of the auxiliaries and the air end of the compressors and vacuum pumps total about 530 feet. Thus there is over one-third as much rubbing surface in the auxiliaries as there is in the main generating units, and as a number of these auxiliaries are automatically started and stopped without supervision, it is evident that they should be not only supplied with a good system of lubrication, but also with one which will start and stop with the machine.

The main units and all auxiliaries in the above plant are equipped with automatic lubricators, and bearing lubrication is supplied by an automatic oiling system, resulting in the very low total cost for all oil used in the plant of less than one per cent. per 1,000 K.W. hours.

The power consumption of auxiliaries is more striking in smaller plants than in large ones; for instance, take one of the large modern office buildings, it is found that only 50 per cent. of the power produced is used by the main generating units, the balance being consumed by elevator pumps, blower engines, vacuum and boiler feed pumps, air compressor, etc. In another plant, in one of the large modern apartment houses, it is found that only two-thirds of the total power is used in the main units, the other third being consumed in refrigerating machines, boiler feed pumps, vacuum system, sewerage, pump, etc.

The above are only a few plants that have come to the writer's notice, but there are thousands of plants where even though the main units are properly lubricated there is still an opportunity of considerably reducing the oil consumption, and increasing the efficiency by providing the auxiliaries with proper automatic cylinder lubrication.

AUTOMATIC BEARING LUBRICATION.

We might divide this kind of lubrication into individual and central oiling systems.

Prof. Thurston's "Friction Loss" gives the following distribution of the friction of high speed engines:

Main bearings, 47.00 per cent.
Piston and rod, 32.9 per cent.
Crank pin, 6.8 per cent.
Cross head and wrist pin, 5.4 per cent.
Valve and rod, 2.5 per cent.
Eccentric straps, 5.3 per cent.

Thus we see that proper lubrication of the bearings is a very important item, and proper lubrication means a cool stream of oil between all rubbing surfaces.

The splash system is all right for a time, but soon your oil becomes saturated with small particles of metal, and not at all suited for admission between bearing surfaces. Furthermore, the oil being at the high temperature of the engine frame, has no ability to carry off the heat generated in the bearings—and lastly, steam leaking past the piston packing and condensing in the oil reservoir soon mixes with the oil and forms an emulsion which has no great lubricating value. The proper system is an automatic one. Here is the result of a little test made in New York City, by an authority, on a bearing four inches in length, having a width of bearing of two inches, the friction and resistance with a bearing lubricated by an oil pad was 7.97 lbs., saturated oil pad, 4.47 lbs., stream of oil, 2.89 lbs.

In the Individual System each machine is a unit by itself, independent of all others, while in the Central System all the used oil for bearing lubrication, from the various machines about the plant, are supplied from a central source. Of course, supplementing the latter classification is hand oiling with cups, which for many years was the only method depended upon, and is now only generally used to supplement automatic lubrication covering such minor points on valve gears, etc., as cannot be economically taken care of by an oiling system.

With the Individual Oiling System each engine unit in the plant is provided with a lubrication system entirely independent of all other units. Each individual system consists of a filter reservoir pumpdrain well and overflow stand.

tached to the base of the filter is a small double acting oil pump (driven from the engine valve gear), one end of which

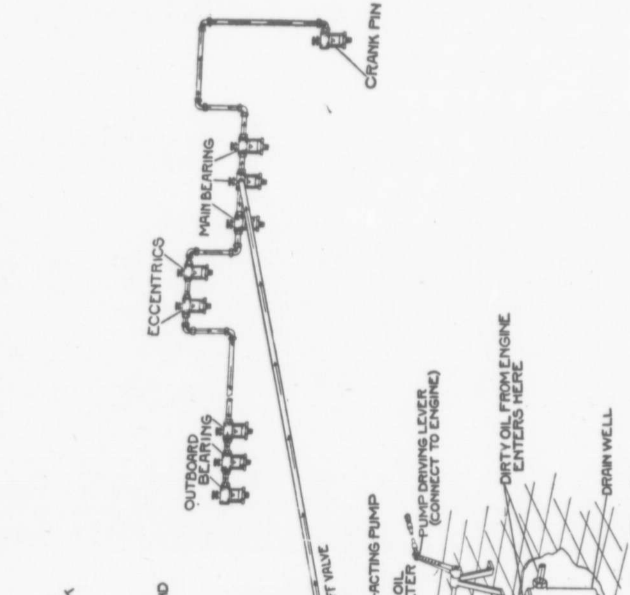

FIG. 3

The filter reservoir is set on the engine room floor adjacent to the machine, for which it is to provide lubrication. At-pumps the used dirty oil from the drain well (to which the dirty oil drains by gravity from the engine), and pumps it into the filter. Here the oil is thoroughly purified and filtered, passing into the clean oil reservoir chamber, from which point it is taken by the other end of the double acting pump and delivered to the piping on the engine connected to the various points to be lubricated. The overflow stand is connected into the piping on the engine, so that any excess oil delivered by the pump rises in the stand to the glass reservoir at the top and automatically overflows back to the filter.

In the Central Oiling System the oil for all units in the plant is supplied from a central source. This system is varied to suit local conditions, and in some plants carried out to the most elaborate detail, as is the case in some of the large electric generating plants. The Central Oiling System is really an extension of the Individual System to take care of the whole plant. A pump is usually provided to remove the oil from the barrels or tank cars and elevated to an overhead reservoir. From this point the oil flows by gravity to the various head reservoir. From this point the oil flows by gravity to the various machines to be lubricated, and after being used it flows by gravity to settling tanks, usually located in the basement. From these tanks it flows into the oil filters, and after being filtered and separated from entrained water it is returned to the overhead reservoir by a pump provided for the purpose. These systems can be laid out on a most elaborate scale, in which the oil is passed through several settling tanks in series, after which it passes through a number of filters and is then pumped into one or more clean oil reservoir tanks.

The filtering apparatus is located in the basement of the power house, and all used oil flows from the engines to the filters by gravity. After being filtered, it flows into an air oil lift, which automatically delivers the filtered oil up into the overhead gravity reservoir. From this point the oil flows by gravity to the various machines to be lubricated, after which it again returns to the filter for filtration. This system also provides automatic cylinder lubrication.

It will be seen that the Central System requires a great deal of apparatus and an extensive system of piping. It is also necessary to have all the apparatus in duplicate, so that in case of a breakdown of any part of the system, the whole plant will not be tied up. The degree to which this duplication is carried out, of course, depends upon the ideas of the designer and to whether it should also include the duplication of piping. For large plants where the supervision is thorough, the Central System has some advantages, but for most plants the Individual System is preferable, and no duplication is necessary. For there is usually a spare engine in the plant which can be thrown into service should the oiling system on one of those in use fail. Although the failure of the Individual System is a remote possibility, as it is so simple that there is practically nothing to get out of order.

There are, of course, an infinite number of combinations and variations of the two general systems which can be used, that is, the group system can be divided into two or three smaller groups, each of which has sufficient capacity to take care of part of the plant, and they can be so interconnected that one will form a relay to the others.

For lubricating the important reciprocating parts on the power plant machinery, such as cross head and crank pins, eccentrics, etc., it is most desirable to use pendulum crank in oiler, and telescopic cross head pin and eccentric oilers, as shown in figure. These devices permit feeding a stream of oil to the bearing surfaces and does away entirely with the hit and miss (mostly miss) method of using wiping devices, drip troughs, etc.

The following table is guaranteed to be correct and was compiled from actual tests. It shows the average amount of oil that passed over the bearings of various engines in order to give the best results. Bear in mind that this oil was not consumed, it was all filtered and used over and over again.

Engine H.P.	Amount of oil in gals. per hour.
100	4
200	6
300	8
400	10
500	12
1,000	22

The above table applies to slow speed engines (not over 200 R.P.M.); add 30 per cent. for high speed engines.

As to which system or combination of systems is to be used and as to the proper method of piping, details of apparatus, etc., most of this is generally left to the judgment of the lubricating engineer making the lay-out. As mentioned in the beginning of this article, the proper application of oil is often neglected, or left to incompetent persons, whereas, it is of as great importance as the steam piping layout.

The writer has seen many plants where the installation of a general lubricating system designed to meet existing conditions has reduced the oil consumption from 25 to 75 per cent. and the lubrication greatly improved.

RESULTS OF PROPER APPLICATION OF OIL.

As an illustration of what can be accomplished in the way of economy by the installation of a properly designed automatic system of cylinder and bearing lubrication—in one of the largest public service power plants in the country, where 30,000,000 kilowatt hours of electric current is generated for a month, the total amount of oil consumed for all the main generating units and their auxiliaries amounts to only 300 gallons of oil per month, and in another large plant the actual cost of cylinder and bearing lubrication only amounts to two cents per 1,000 kilowat hours. In the power plant of a large New York office building, operating three Corliss engines and several auxiliary machines, a well designed oiling system was installed, and the total consumption for both cylinder and bearing lubrication amounted to only seven barrels per year.

Contrast these results with an average cost for cylinder oil alone of 6.19c. per 1,000 H.P. hours, as recently published by a prominent engineering journal which tabulated the consumption and cost of cylinder oil in 81 power plants. Take an ordinary industrial plant operating a 1,000 H.P. engine consuming 25 pounds of steam per H.P. hour, operating 10 hours per day for 300 days in the year. A proper oiling system will reduce the steam consumption 2 to 7 per cent. Taking a minimum of 2 per cent., we find a saving of 1,500,000 pounds of steam per year. If steam is worth 25c. per 1,000 pounds, the system will pay a yearly dividend in steam saving of $375.

An engine or machine equipped with an oiling system so that a small stream of oil can be supplied to all bearing surfaces, will run much cooler, wear longer, and do away entirely with the necessity of keying up as tight as is necessary where lubrication is provided with oil cups feeding the oil drop by drop. The writer has frequently taken the pound out of a cross head or crank pin by applying a small stream of oil, which filled up the intervening space.

From the above it will be readily seen that this all important subject of lubrication is one that deserves special attention, and as lubricating oil is something that is always necessary to supply as long as a plant is in operation, any economies effected will result in a lasting reduction of operating expenses.

Chairman,—

You have all listened with great interest to Mr. Pratt's paper on lubrication, and there is no doubt we will have a good discussion on this subject.

Mr. Wickens,—

Some of us here to-night have graduated from the old coffee pot game and there is no doubt we wasted a great deal of the oil we attempted to use in our cylinders, and on our bearings and a good many of our engineers to-day are not careful enough in the use of oil.

The old plan of oiling journals, whether engine journals or shafting journals, by going to them occasionally and putting the oil on by hand is certainly obsolete to-day In those days the man generally left it as long as he could, possibly until the bearing began to get hot and then he would probably get excited and pour oil all over the bearings and on the floor all around in his endeavour to prevent the bearings becoming too hot. You can go into almost any factory, where lubrication is managed in that way and see plenty of marks around the floor, indicating that there has been hot bearings.

Forced lubrication is the proper thing for all running machinery. I had the pleasure, a short time ago, of looking at two 350 h.p. engines that had been running for two years at 325 and 350 r.p.m. These engines had never been shut down. They were running about ten hours a day, 300 days a year. With the lubricating system they had, they used about a 12-pound pressure for pumping the oil, which gathered in the base of the machines, and was eventually run out through filters and used over and over again. I cannot tell you the exact amount of oil they used, but I do know that their actual loss was not very great.

There are a great many things in connection with lubrication now that are of vital interest to all engineers. Now that we are beginning to use superheated steam we are going to have a little difficulty, especially with the lubrication of cylinders and valves. In many instances, where you heat steam up to 150 degrees greater height than the ordinary steam pressure, it means that we will have very dry steam, and in using a vapor that is practically dry, it is going to be more difficult to lubricate than with ordinary steam and oil men are going to have some difficulty in giving us oils that will stand that high heat.

A number of years ago, Mr. Isherwood (one of the greatest men in the United States Navy) experimented along the line of using superheated steam and his report was that it was quite feasible provided that they could lubricate the cylinders. In those days they were using animal and vegetable oils, they had no mineral oils such as we have these days, consequently they were unable to properly lubricate their cylinders, but since the introduction of the high grade mineral oils, the heavier grades of which are capable of standing very high temperatures it has opened the way for oil men to supply us with an oil capable of standing the high temperature necessary and when this is done we will be able to use superheated steam to great advantage.

There are a great many points in the paper that are of great interest, and Mr. Pratt has given us something to read and think over carefully and I have no doubt the paper will prove of great use to us.

I would like to ask Mr. Pratt at how low pressure the forced system of lubrication can be successfully worked in individual units?

Mr. Pratt,—

With our lubrication we could work anywhere up to 11 pounds pressure. I cannot say just how low we went, we never tested to see. We always tested the pumps to see what pressure they would overcome.

Mr. Wickens,—

The point I wanted to get at was: How low a pressure would be suitable to drive oil between the shaft and the bearing to make perfect lubrication?

Mr. Pratt,—

I do not know whether I can reduce it to pounds of pressure. We had at least, always 2½ feet of head of oil, nothing lower than that. In the English engines, for which they claim a very high efficiency (97 per cent.), which I believe is due largely to forced feed lubrication.

Mr. Wickens,—

In the English engines they were using about fifteen pounds forced feed lubrication in their journals.

Mr. Bly,—

There is one point it seems to me we ought to take up and that is the different grades of oil. It does not mention very much about this in the paper. We have a great many men coming around with oil. One man says, I can give you an oil at 65 cents, 75 cents, or 80 cents.

The question has come to me, where do we strike an average when we go to buy oil. I find that for a fairly reasonable price I can get along very nicely. I have never made a test to know how much is lost by friction.

I shall be glad if Mr. Pratt will give us something in regard to the price of oil.

Mr. Pratt,—

I would not care to recommend any particular kind of oil. In my paper I gave one or two simple ways of determining a good oil from a poor oil. I think you must expect to pay anywhere from 30 cents to 40 cents for bearing oil and about 70 cents to 75 cents for cylinder oil.

Mr. Bly,—

One engineer pays 25 cents for his oil and another pays 75 cents. Is that a difference in the oil or a difference in the engineer. This is a point that seems to me to be important. A salesman comes along and says I see you are feeding 4 drops to the minute into the cylinder. I can sell you an oil at 75 cents, which will only feed half that quantity and you will get as good lubrication from the two drops as from the four. How is that?

Mr. Pratt,—

I do not think you would be able to do that unless one oil was twice as good as the other. As I said you have got to feed your oil in such a way to your cylinders that you will get a certain amount with each stroke of your engine. If you only feed four drops, and the engine is running 200 r.p.m. you only lubricate your cylinder once every fifty strokes, but if you have forced feed lubrication you can have oil fed in at each stroke.

The whole point, to my mind, is the personal equation of the engineer. Some men think they can get along with a cheap oil, but poor lubrication is a thing that does not show at once, and your engine may run along for some time poorly lubricated and not show it. Eventually the result will be the wearing out of the cylinders long before they would have, had they been properly lubricated.

Mr. Bly,—

If you use a cheaper grade of oil and use more of it would you not get better results than using a better grade and a smaller quantity.

I know one plant I had to do with. When I went there the man was using 65 cent bearing oil and 85 cent cylinder oil, and I ran the same plant for over five years with 16 cent or 17 cent bearing oil and 45 cent cylinder oil, and I had no cylinders bored or bearings replaced, except the babbit in a couple of crank bearings replaced after seven years, and the other bearings seem to me to be running as well as they did seven years ago and he was using about three times as much. Where is the difference?

Mr. Pratt,—

It is pretty hard to say. The whole subject is a difficult one and that is why it has gone along so slowly. What I have tried to point out is that if you use lots of oil and use it over and over again you will not have much waste. I put in a system in the Montreal Light, Heat and Power Company, which had 1,300 feet of shafting and we used about 135 gallons per month before I put in an automatic system. It took some ingenuity to put it in, but after it was in we only used 60 instead of 135 gallons per month, and we used it over and over again.

With the forced feed system you can regulate the oil so that your cylinder will get some oil at every stroke, but with the old system if you do not feed enough you are going to score your cylinders. If you feed too much you are going to waste your oil and if you use your exhaust steam you are going to have trouble with the oil being carried away with the steam.

Chairman,—

My experience with oil is not very great, but imagine it is like other articles placed on the market, which can be adulterated to suit the different purchasers; but after all is said and done, in order to get good oil you must pay the price for it.

I think we have had a very good discussion of this paper, but if there is anyone else who has anything to say we shall be glad to hear from him.

Mr. Stainton,—

I have found that the best way in cylinder lubrication is to use not too good a quality of oil and feed fast.

In lubricating shafting we have a system which I think is about as good as you can get. We have an underneath dish on the shafting and feed the oil on to the bearings with a wick. The shafting will run nine months this way after which we clean out the dishes and fill them up again and it is a rare thing to have anything get hot. That is, of course, unless the wick gets choked up, if it does that, naturally it will not feed the oil.

Mr. Baldwin,

I am sure we have all listened with a great deal of pleasure to the paper read by Mr. Pratt and I have great pleasure in moving a hearty vote of thanks to Mr. Pratt and trust that at some future time we shall have the pleasure of listening to a further paper from him.

Mr. Carmichael,—

I second that.

Chairman,—

Moved by Mr. Baldwin, and seconded by Mr. Carmichael, that a hearty vote of thanks be tendered to Mr. Pratt for the excellent paper he has read to us to-night. Carried.

Mr. Pratt,—

I thank you very much for the hearty vote of thanks. In regard to Mr. Baldwin's suggestion, I may say that I shall be very glad to give you a further paper on this subject and at the same time I would like to illustrate the paper by means of lantern slides, as I have access to some very fine slides.

Chairman,—

In further reference to the picnic, I might say that in former years we have sold our tickets to practically anybody and everybody. This year we are going to confine it to members only. We have between 500 and 600 members, and we should be able to get at least 150 of them to turn out and we will enjoy the good things among ourselves.

Moved by Mr. Herriot, seconded by Mr. Carmichael, that the meeting be adjourned. Carried.

For Sale