# DISCUSSION.

Mr. James Kidd, in opening the discussion, said that this Association was much indebted to the author for his valuable paper, as this subject was calling for a great deal of attention on the part of engineers at the present time, but the question of instaling motor drives in place of the steam engine, was a matter that required careful consideration as to the conditions and nature of the work to be performed, and whether the results would be economical. He would mention that at the Pyrmont Refinery they generated their own current with a Belliss engine with forced lubrication direct coupled to a Crompton generator and their experience with this plant had been very satisfactory; it had been running night and day for twelve months, and they had not had occasion to put a spanner on it, and it required little or no attention.

With a large, scattered place like the Pyrmont Refinery they had found the electric installation a success, and it showed a saving in coal, labour, and maintenance. They had 70 motors, the total h.p. 509, and 380 lights being worked off the generator of 300 h.p., which showed the intermittent work of some parts of the factory.

Referring to Plate VI., in which the readings of the Pyrmont workshop showed 15 h.p. as being now lost driving shafts and loose pulleys, he would have liked Mr. Erskine, had he been present, to show how he would save this loss of £312 per annum by installing separator motors or grouping of machines.

In a shop such as Pyrmont, where the speed of the various machines were mostly below the ordinary speed of the motors, reducing gear or belting with countershafts, would have to be resorted to, this, with the larger loss of efficiency by having a number of small motors would come to the same thing, he could understand where the machines would be stopped for a considerable time, a saving would be effected, but not where the running was nearly continuous. As the author quoted from Mr. A. D. Williamson's paper on the driving of machine tools, he might be permitted to quote him again further from the same paper. Mr. Williamson said, as regards the relative efficiency of line shaft driving and individual motor driving, he thought there was very little to choose between the two. He considered in detail three alternative ways of driving a line of ten lathes, each requiring 5 h.p.

1st. By one 40 h.p. motor and line shaft 110 feet long.

2nd. By ten 5 h.p. constant speed motors, with belt drives and step cones.

3rd. By ten 5 h.p. variable speed motors geared direct to lathes.

The relative costs of these three arrangements were:— 1st, £410; 2nd, £575; 3rd, £685, and the total running losses including losses in shafting and motors were (1st) 8 b.h.p.; (2nd) 9 b.h.p.; (3rd), 7.5 b.h.p

If the lathes were always running, there would not be much to choose between the systems, but such were not the actual conditions of working. Mr. Williamson said working conditions might be fairly represented by assuming eight out of ten lathes to be in use. Working on the basis of eight lathes working out of ten, he made out the saving in consumption in favor of individual motor driving as £13 per annum, reckoning energy at .75 penny a unit.

Deducting 4 per cent interest on the difference in cost of the two systems, the apparent saving was only £2, and he thought that this would fairly apply to Pyrmont workshop working under the present conditions.

In arranging for motor drives the author referred to the question of reducing gears to high speed motors, but he was of opinion that unless the speed required was exceptionally slow, it would be more satisfactory to have a motor of slow speed, although at a higher first cost, and do without the reducing gear. Mr. Erskine pointed out that gearings were now attainable with a reduction of 10 to 1 giving an efficiency of 98 per cent., but they had recently imported two from a well-known maker, and this high efficiency had not been met with in either case, and they were now installing reducing gear of their own design, of the worm and wheel type, with ball bearings to take the thrust with satisfactory results.

He quite agreed with the author's remarks on the question of cutting down the size of motors for certain work, and one that should be avoided in any arrangement, as the results only lead to trouble.

They had motors arranged to do various classes of work, amongst which were five of the vertical type direct coupled to centrifugal machines, four of these were of the Potts, Cassels & Williamson type, the armature and spindle of the machine being rigid, and the fields swung so that any movement of the spindle, which was hung from the top, would be followed by the fields, but they found that the intention of the makers had not been fulfilled, although it was an improvement on the belt drive. The fifth machine which was of the Watson Laidlaw patent, had many advantages, the motor in this case was not affected by any movement of the machine spindle, and should it be found necessary to examine the machine, the motor could be raised by worm wheel gearing and swung out of the way in a few minutes. The efficiency of this machine compared with the same class of machine water driven, showed an advantage of about 20 per cent. These motors were coupled to the centrifugal spindle by means of a centrifugal friction clutch, and by this arrangement the machine took up the load gradually.

They also had motor driven elevators, jiggers, conveyors, and sugar carriers, and to show the adaptability of motor drives, he might mention that with one of the sugar carriers they had loaded sixty single drays, each carrying a ton of thirty-two bags, in under one hour, which for speed could not be carried out with any other form of drive.

They had also two Edwards' air pumps, driven by a 27 h.p. motor, and this had proved very satisfactory. There were also fourteen air fans direct coupled to motors, with flexible leather link couplings, ranging from 20 down to 2 h.p., and for this class of work it seemed particularly suited.

There was also a three chamber centrifugal pump, coupled direct to a motor, throwing 8,000 gallons of water per hour, against 150 feet head, with satisfactory results. At one part of the factory they had an engine and about 300 feet of shafting, this without any load took about 10 h.p. for the engine and shafting alone; and as they at times only required about 2 h.p. effective work for several hours, they installed some twenty motors, with a large saving.

At another part of the factory, some two hundred yards from the main boilers, it was necessary to install a boiler to work that part, burning twenty tons of coal per week, and they had now by motor drives done without the boiler, and saved this quantity of coal.

Having recently had occasion to look into the question of power for working the organ of a large city church, he paid a visit to several places to see what had been done in this way. At one church he found a continuous speed motor, without automatic control, fitted to reducing gear of the spur wheel and pinion type; on the air receiver a safety valve was fitted, so that when the air rose to a certain pressure it went to waste. This meant that when no air was taken by the organist, the motor was running under the maximum load, and when a large quantity of air was being taken, the load was reduced on the motor. This arrangement was, no doubt, of great benefit to the company who supplied the current.

The best arrangement of motor drive was to be seen at St. Phillip's Church, and was worked automatically, and was far more satisfactory than hydraulic power for this class of work, and it would be a difficult matter to improve upon; and the cost per Sunday was about threepence for current.

The author referred to the strong feeling among engineers, with reference to the future of the gas engine with producer gas, and it might be of interest to the members to know that they had recently installed at Pyrmont an alcohol engine, the first, he believed, in Australasia, which ran on 1-10 of a gallon of methylated spirit per horse-power per hour, which cost under a penny per horse-power per hour. The component parts of the methylated spirit used, consisted of 90 volumes Alcohol, 10 volumes Wood Spirit, ½ volume Kerosene.

Quoting from the "Engineer," of 15th April, 1904, at page 399, the difference of efficiency between alcohol and petrol was as follows:—

| | Heat of Combustion. | Efficiency. | Available Units |
|---|---|---|---|
| Alcohol .... | 5.500 | 32 per cent. | 1.760 |
| Petrol ..... | 10.250 | 12½ per cent. | 1.280 |

The explosive pressure for 90 per cent alcohol was 500lb per square inch, and at that pressure compression was quite safe, and these motors were commonly used under these conditions, and from experiments made, these alcohol engines had given 32 per cent. efficiency of the heat value of the fuel, and there was no doubt that this form of power would come to the front here, as it had done in England, and the British Government were now considering the question of reducing the duty on spirit for commercial purposes. He would also mention that there was no smell, it was nearly noiseless, and left no deposit.

Mr. C. Holroyde said he had read the author's interesting paper with pleasure, and he regretted that more details were not given, especially as to how Tooth's Brewery plant was converted and what had been the result of such conversion. Plate III. showed the load on such electrification, but what had been done in the way of economy or other advantages was not shown.

We had no figures to prove that any advantage had been gained by such change. Probably, if the machinery had been laid down under different conditions in the first instance, results might have been in favour of the steam drive; he would not say it would, but he believed that steam driving under certain conditions was just as economical as electrical driving.

He would now describe his experiences of driving by electricity, and before entering on that, he would like to mention that he was not wedded to any particular motor on the market, and did not intend to advertise the plant that was working in the "Daily Telegraph" office. His opinion was that all the well-known motors were good, and there was nothing to choose between them. He had used Crompton Generators for twenty-two years in the colonies, Westinghouse generators and motors, Brush generators, and others, and had always found them satisfactory.

The plant under his supervision was a "direct current" plant of the General Electric Co.'s make, and had been put down according to his views of how motors should be applied to printing machinery. The current was supplied by the City Council on the three-wire system, delivered in duplicate from two sub-stations, and duplicate mains from the Power House to the sub-stations. The City Council had their meters, and their switchboard had meters corresponding to theirs. Throw over sub-station switches were provided, and pilot lamps to indicate which station was off or on.

He considered a newspaper office offered an ideal example for motor driving, as the running of a paper was different to either that of a brewery, sugar works, or shops of magnitude. There was such a vast difference in such plants in many ways. The running of a printing press altered under many conditions, such as variation in impression, setting of rollers, quality and texture of paper running through, speed at which it could be run under such conditions, hot and cold weather, all these making vast differences in cost of production. The first portion of the plant he proposed to describe was the Linotype Machinery. There were nineteen of these machines, and each one was belted to a ¼ h.p. shunt slow speed motor. The number of lines turned out of one machine per unit was 2,000, equal to 4¾ hours continuous running (brevier type), or seven lines per minute. The advantage in belting this machine instead of by direct gearing, was that should any undue pressure be brought upon the machine, the belt tightening pulley gave with the strain and allowed the motor armature pulley to revolve within the belt, so saving accident to the motor or lino.t machine. These motors were fitted up with field control rheostats, so that the speed could be varied to suit the operator's speed of work. They usually ran these machines at 68 revs. per minute, but the "Daily Telegraph" ran at 74 revs. These machines had been running eighteen months, and they had not cost 20s for renewals and replenishments of oil to ring bearings. Each machine had a switch placed in a convenient position to the operator's seat, and he could start and stop it according to requirements. The cost of current (nineteen machines), labour, and oil, was 22s per week, as against steam costing 87s per week for coal, water, wages, and oil. Before these motors were attached, they were driven by a Tangye 8 N.H.P. engine, driving over 200 feet of 2in. shafting, situated some 100 feet away, in another building, and on a lower floor level. The engine started up at nine o'clock in the morning, and with the exception of two half-hour stops, ran twenty-two hours consecutively every day of the week, except Sundays, when it was started up at 7 p.m. He considered the waste power in this case was sufficient to drive all the lino machines, viz., 4¾ h.p. The amount spent in renewals of belts and bearings, grease, etc., would easily pay for the current consumed by the motors. He might mention that the vibration on this floor now was nothing to what it was. Underneath one could hardly hear the lino machines running. The next department was the stereo room, and he thought everybody would agree with him that this was a clear case of improvement. In this department all the plates were cast, some 40 or 60 plates a night, according to sizes of the paper. The plates were semi-circular when cast, with the letters of reading matter on them, and were bored out to fit the radius of the machine plate cylinders. It was in this department that he made his tests with a 7½ h.p. Westinghouse motor, continuinng the tests for twelve months before he could convince the management that there was anything in the electrical drive. When he handed in his report and figures, Electricity v. Steam Drive, that there was evidently something in it, for it converted them.

This department was situated on the second floor, the engine that supplied the power, being in the basement. In order to drive it was necessary to start up the 18in. x 36in. engine (130 h.p.), which meant 60 feet of 5in., 4in., and 3⅜in. shafting, besides three heavy counter shafts, in order to drive the shafting belted to the stereo machinery. The machinery in this department consisted of the following:—

2 Casting Boxes, taking 1-8 h.p. each .... equal 2-16
1 Plate Boring Machine, 2-55 h.p. .......... equal 2.55
1 Plate Lift, with Plates in, 2-95 h.p.
1 Plate Lift, when coming up, 2-25 h.p. .... equal 2.25
Power to drive shafting, etc., 2-95 h.p. .... equal 2.95
making a total of 9.91 h.p. if everything was on at once. He found by observation at the busiest time, that hardly any time was the machinery on all at once, so that the load on the 7½ h.p. motor was but a small item.

He decided when the contract was let to put in a 5 h.p., for the following reasons: That it only took 5 seconds for the casting box saw to run through the tail of the plate. The borer required 11 seconds to bore a plate, and the lift always or nearly so came up empty, and 20 seconds to come up 45 feet. So that putting all on, it would amount to a load of 12 seconds, which, in his opinion, was not too much risk. In an afternoon this plant ran on an average 5 runs of 5 minutes, 4, 4, 4, 4, say 21 minutes between 3.30 and 5.30. On the steam drive the engine started at 3.30 p.m., and with the exception of a 24 h.p. thrown on 15 to 20 minutes, ran for the stereo department. It had to be run full open, because it was never known when the full power would be required. The waste power on this drive was 29 h.p., without taking into consideration wear and tear of belts, bearings, oil, grease, coal, etc., etc. The cost of steam drive was 20s 6d per week for the 3.30 to 5.30 run. Cost of the 7½ h.p. motor 11s 6d (including afternoon and morning editions), and by the 5 h.p. as at present, 8s per week for the same time. The present plant was to be replaced by a considerably larger and more up to date one, which was expected shortly. On the new plant each machine would have its own motor attached of the C. & C. pattern. He did not think much would be gained as regarded economy in current, only in case a single motor drive went wrong it would be advantageous.

The Damping Department consisted of three machines, taking a four-pole 3 h.p. .600 revs. per minute, 240 revs. "special slow," variable speed compound wound direct current motor for each machine. They were similar in design to the lino motors; speed of these machines varied from 60 to 120 revs. per minute. Heaviest load taking 8½ amps., machine running empty on full speed 3½ amps. These machines put through 160 reels per week each; each reel weighing about 8 cwt., and took about 50 minutes each to put through.

The application of the electric drive in this case was about the best it could have been put to, for the following reasons: When it was on the steam drive, driven by a separate engine, it was necessary to ease down the engine if a reel of paper was running badly, which often happened after transit, or conditions of make of paper. If one of these reels happened to be running very badly on one machine, and two good ones on the other machines, the engine had to be slowed down at the expense and loss of time of the other two, if they were running well. A considerable loss of time was experienced in this, fully 25 per cent. Now each one could be run according to requirements, which expedited the work and costs less, being 50 per cent. less cost than steam drive and more work done.

These machines were belted,, the motor being below the floor level. He had a compound belt running on one machine, which gave better results than single driver-less slip, and not necessary to be so tight. The controller, conveniently placed on the side of the machine, was similar to the tramway controller, but smaller, and had running speed notches; it could also be reversed if required.

The printing machinery, he thought, was the most difficult problem to solve, in order to get good driving at high speeds and proper braking equipment. He would first describe the Hoe machine, and the work it had to do. The three reel type press, capable of turning out 24,000 papers per hour of the following sizes: 8, 10, 12 pages, 7 or 8 columns wide, and 12,000 papers per hour of 16, 20, 24 pages, also 7 or 8 columns wide. The paper was printed, pasted, folded, and delivered by the machine. To start this heavy machine, an unusually strong effort, or torque, was necessary, and it was most essential that the start should be slow, and the acceleration very gradual, otherwise much damage might be done to the press. It was necessary to drive the cylinders at numerous and certain speeds for various purposes, and for various lengths of time, and to be able to stop the press quickly, in case of an emergency, without shock or jar; should the stop be too quick the gears might be stripped. The process of printing was as follows: When the press was to be prepared for running out an edition, it was inspected, cleaned, and oiled, then driven slowly for a few minutes to see that all was in proper condition. Then it was "made ready." The paper rolls were placed in position, and the pressmen began "threading in" the sheets through the machine. This was a delicate and tedious operation, and here was where the necessity for nice graduation of speed and ease and simplicity of control came in, for the sheet must be threaded carefully and slowly, to prevent its breaking up. This operation required the stopping and starting of the press many times, and turning the cylinders from a quarter of a turn upward at a time. This done, the speed was gradually increased to about one-tenth of its normal speed, in order that the sheet ran properly. As the plates came from the stereo department, they were now placed in position on their cylinders. As these plates had to be securely fastened in different positions, it was necessary that the cylinders could be stopped in such positions that the pressmen could readily get at the fixing screws, so that it was essential that the press be started and stopped many times. Ink rollers and plates were adjusted, and if everything was satisfactory the speed was increased and run at normal speed unless there was occasion for a rush, when it was driven at an extra speed. Having described the routine of the machine, he would endeavour to explain how the motors were applied at the "Daily Telegraph" office. The machine was direct driven by a raw-hide pinion, 6in. P.L.D., 14 teeth, 1¼ pitch into the machine wheel 18in. dia. 46 teeth, 1¼ pitch, and the pinion that had been driving for the last eleven months, he was glad to be able to produce it for inspection. Now, as regarded this wheel, electrical experts said that the wheel was not capable of transmitting the power. This, he thought, was a matter for discussion. The horse-power of the machine was 24, according to the makers. His tests by steam (and also a test made by Mr. J. R. Thompson, consulting engineer) both agreed that the power required to drive the machine was 24 h.p. Electrical experts said that the machine took anything between 20 and 50 h.p., according to conditions.

The motor equipment of a machine was as follows:—The main motor was geared to the press shaft, on the side opposite the pulleys, so that in case, the electrical power giving out, the belt drive might be substituted, without causing any delay. The motor pinion had a taper fit, permitting of its being readily removed from the armature shaft, thereby entirely disconnecting the motor drive, from the press. The main motor, rated CE—2—5 h.p.—1100, 480 volts compound wound, was geared to the shaft, of the main motor, through a worm, and ratchet worm wheel. The ratchet worm wheel, being mounted on the motor shaft at the commutator end, and provided with a ratchet such, that after the auxilary motor was brought up, to full speed, the large motor could be started, overhauling the ratchet when the speed of the larger motor, exceeded that of the worm wheel. The auxilary motor was so geared that a speed of from zero to ten revolutions of the main press shaft could be obtained by armature control. After the small motor had been brought up to its maximum speed, the large motor was thrown in and brought up to its maximum full field speed, after which in-