not carry the load. A natural answer to this would be to increase the size of the belts. This will suffice in some cases, but there are numerous instances where either there is not room to increase the width of the belt or if step cones be used the number of steps will have to be decreased and means (such as multiple counters or additional gearing) taken to complete the speed range. Further, it is difficult to shift large belts, and this method generally results in much loss of productive time. Tools that are limited in their production because of the lack of power at the tool are a source of great expense to the manufacturer, not only on account of the unproductiveness of the tool, but on account of the excessive labor expense due to the additional time required. The power cost of the production is comparatively small, roughly, varying from one to three per cent., while the labor cost is usually a very heavy item of the production cost, say, fifty per cent. or upward. If, therefore, by increasing the power on a given tool its output can be increased, the conclusion is obvious.

Up to a few years ago in the majority of shops where motors were used they were usually belted to the lineshaft or countershaft of the tool. Adjustable speed motors were not so commonly used then as now nor were they made in the great variety of sizes and speeds now obtainable. To-day, especially in the case of new tools with their requirements of high power and close speed regulation, it becomes not only more convenient, but in many cases almost a necessity to apply the motor directly to the tool.

In driving tools with individual motors it will be noted that the motor not only supplies the power and speeds best adapted to the tool, but that in the case of the variable speed tools the speed range of the adjustable speed motor, alone, will in many cases cover the entire speed range of the tool. The motor and its controlling apparatus should, whenever possible, be connected direct to the tool, thus making a compact unit which has also the additional advantage of allowing the tool to be moved by simply disconnecting the leads and connecting them in the new position. In the case of portable tools this, of course, is an absolute necessity.

Many tests have been and are being made to determine the kind and horse-power of motors that should be used for different types and sizes of tools, but up to the present time the motor is generally thought of only as a means of driving the tool and not as to its possibility of becoming one of the main elements of the tool construction. Recent motor improvements will produce many new designs in tools with corresponding higher efficiencies.

While there are numerous motor applications to machine tools which are a decided credit to the machine designers and for which due credit should be given, there are still many motor applications where it is only too plainly seen that the motor is an ofter-thought and thus much of the advantage of the application is lost. In order to derive the greatest advantages from the motor drive, the motor should, as far as possible, be direct-connected to the machine. For example, a recent up-to-date motor application to a machine in common use and one that had been motor-driven for several years, abolished belts, three sets of bevel gears, two splined shafts and considerable other gearing; the motor being applied directly to the machine spindle. There are to-day many cases where motors are driving machines through unnecessary auxiliary apparatus such as belts, gearing, etc. This additional apparatus not only takes up valuable floor space and wastes power, but fails to give the maximum output available when the motor could be connected directly to better advantage and in some cases at actually less cost. From the foregoing it will be seen that the advantages derived from an up-to-date direct method of applying the motor not only increases the productiveness of the tool, but decreases the actual power required to the extent of the friction load short circuited, and also decreases the first cost of the motor on account of the less capacity required. The writer knows of cases where improved drives have cut the power required to half and even less. A cheap first cost is often an expensive investment.

The advantages of the individual motor drive for large tools and for certain of the smaller tools have been conceded for years, but there are many tools where either the cost of the motor or the cost of applying the motor to the tool on account of the construction of the machine is prohibitive. The motor should be a part of the tool rather than a mere addition to it.

Better drives are possible now than formerly, due to the greater motor speed ranges obtainable and to the decrease in dimensions per horse-power of the motors, to more perfect balance of the rotating parts and, to a certain degree, to improvements in gears which allow higher speeds without excessive vibration and noise.

The improvements in control appliances have kept pace with the motor development. Much more exacting requirements of both motor and control are now demanded. Motors driving machines reversing ten times per minute, twenty-four hours per day are now not uncommon. Duty cycles that were impossible to meet only a short time ago are now not only practicable but common. With the great variety of motors and controllers now on the market and the large quantity sold, sometimes without the manufacturer even knowing for what service they will be used, it would be surprising if trouble did not occasionally occur.

Much of the success of a motor-driven machine depends on its control. Magnetic control, which is coming into more general use than formerly, somewhat complicates the control situation. While the possibilities of magnetic control are infinitely greater than the older types of control, likewise the chances for misapplication are greater. However, as the characteristics of the different types of control become better known these complications will disappear.

In the report of Mr. J. McLeish, issued by the Department of Mines, Ottawa, on Economic Minerals and Mining Industries of Canada, the production in 1912 of the three following minerals was as follows:—Lead, 35,763,476 lbs., at the value of $1,597,554; Corundum, 1,960 tons, at the value of $239,091; graphite, 2,060 tons, at the value of $117,112.

In the report of Mr. J. McLeish on Economic Minerals and Mining Industries of Canada the following statistics are given for 1911 and 1912 for the total value of the outlay of clay products in the following provinces, thus:—In British Columbia, for 1911, $675,505, for 1912, $996,568, showing an increase of $321,063; in Alberta, for 1911 $1,052,751, for 1912, $1,356,184, showing an increase of $303,433; in Ontario, in 1911, $3,916,575, in 1912, $4,864,700, with an increase of $948,125; in Quebec, in 1911, $1,341,467, in 1912, $1,680,300, with an increase of $338,833; in Nova Scotia, in 1911, $274,249, in 1912, $272,053, showing a decrease of $2,196.