RELATIVE ADVANTAGES OF ELECTRIC AND SHAFTING DRIVING FOR SHOP USE.*

A comparison of the relative advantage of electric and shafting driving for shop use may be made under the following general headings:

1. Relative economy in cost of power itself.

2. Relative convenience of operation and installation.

3. Relative effect upon shop output and cost of labor.

Referring in detail to the scope of these considerations:

1. Economy.—This has been taken to comprehend only the relative cost of operating the two systems, including expense for fuel, attendance, repairs, interest on investment and depreciation. It is the reason most generally advanced for the installation of electric power, but can only be the controlling one where the cost of power is a large proportion of the shop running expenses.

In order to compare the relative efficiencies of engine and electric transmission, it will be necessary to subdivide the character of shop plants somewhat. To do this completely would lead to endless complication, but for present purposes the typical plants are:

1. Shop plant in which each building has its own power plant.

2. Shop plant in which all the buildings are furnished with power from a central source.

The matter of connection from the prime mover to the tools may be assumed, for an extreme comparison, in either of two ways, viz., (a) shafting method; (b) individual tool driving method.

Taking the first condition the average efficiency from engine to tools for steam engine transmission is shown to be 50 per cent.; for electric transmission, under condition "a," the shafting losses will be reduced by splitting up long lines and by avoiding cross-belting, so that they will not exceed 20 per cent., or an efficiency of 80 per cent., and in the electrical elements, as before shown, the efficiency from engine to shafting is 65 per cent.; therefore, the final transmission efficiency will be 80 x 65 = 52 per cent., as against 50 per cent. in the purely mechanical method; or, practically, a stand-off. Under condition "b," much less shafting will be employed, and the electrical portion may also show a better all day efficiency, under certain conditions, by the shutting down of idle machines—say, a shafting efficiency of 90 per cent. and an electrical efficiency of 66 per cent., or a resultant of 60 per cent showing a gain for the electrical method.

Taking the second condition and assuming an unfavorable condition for shafting transmission, as in case of a shop having each building with its own boiler plant and one or more engines, and compare this with a central power plant for electrical transmission to all buildings, the possible fuel saving in the latter arrangement will result first, from some small saving in power required for each individual building, as before shown, and second, from some very considerable saving due to the better efficiency of a large engine and boiler plant over that of several small ones. In extreme cases, where large condensing engines displace non-condensing ones, and in large stations having a uniform load, the fuel saving may readily approximate 33⅓ per cent.

The item of attendance will next be considered. It is made up of three classes of labor—engineers and firemen; care of shafting and belting; electrical repairs. In an electric system the cost can be reduced by consolidating the engine and boiler plants and by the elimation of large and heavy belts, large shaft bearings and the consequent danger from over-heating, reducing labor probably one-half; but a new item of expense in care of electric machinery will be introduced, which will about offset the other items, leaving the whole attendance bill practically unaffected by the introduction of electric shop power in plants of any considerable size.

As to repairs of shafting and belting, it is difficult to obtain accurate data, the record of these items being seldom kept separately in shop accounts. The records of one large establishment have, however, been examined by your committee and the saving found in these items, under the electric driving system, is found to be more than sufficient to pay for all repairs to motors and lines. Thus the conclusion seems justified that the repair item will not be materially different under either system of driving.

The remaining items of power cost are depreciation and interest of investment. It is difficult to institute a fair basis of comparison between the first cost of an electric and steam transmission plant, for the reason that the results sought to be accomplished by the former provide additional shop facilities, and are therefore not rightly chargeable in a substitution sense. Considering, however, the case of simple substitution in a single shop, where the power plant and arrangement and number of tools is retained as before, electric driving is certain to involve a largely increased first outlay—approximately double that for shafting method. But in a modern shop plant other considerations are the guiding ones in a selection of the power system, such as the possibility of labor-saving devices, cranes, etc., and the greater cost of the electric system becomes a rightful charge against the advantages so obtained.

Dropping, therefore, any attempt to draw a strict comparison between first costs, it may be said that in estimating the total cost of power machinery it is usual to include an allowance for interest and for a sinking fund, with which to replace the plant when its utility is no longer on an equality with best practice. These items are generally figured together at 10 per cent. on first cost, a sum amounting roughly to one-fourth of the total running expenses of the power system.

CONVENIENCE AND SHOP OUTFIT.

These considerations are so closely interdependent that they can best be referred to together.

The ordinary shop plant with steam power transmission, both in the arrangement of building and of machines, is the slave to the limitations of this system; it must be laid out so that the shafting and engine connection is as direct and simple as possible; the machines must be compactly arranged in parallel lines, and the ceilings and columns designed with special reference to shafting supports. In other words, the tools must be installed with first reference to the application of power, and not, as should [...] case, with reference to handling the work [...] advantage. Handling operations are of [...] sity largely by manual methods, and the buildings, even, must be located with first [...] to getting the power to them with the least [...] wardness and expense.

While generalizing in this manner, your [...] mittee has not lost sight of the fact that [...] ling and transferring machinery may be oper[...] by other means than electricity, but it is eq[...] true that devices of this nature are of lim[...] practical application, and the broad fact rem[...] that electricity is to be credited with usheri[...] a new era of labor-saving shop devices.

Electrical transmission places no restric[...] on the location of the machines, and each s[...] may be planned with a view to handling its [...] duct with least waste of labor and with [...] greatest convenience of access to the to[...] These may even be transported from place [...] place to the work; further, the partial or e[...] absence of overhead line shafting insures bet[...] lighting of the shop and conduces to cleanliness [...] These factors promote cheerfulness and an i[...] provement in both quantity and quality of o[...] put.

The clear head room permits the univer[...] application of various forms of travelling cra[...] for serving the tools and for conveying ope[...] tions, furnishing the most efficient means [...] developed for increasing shop economy, and [...] a means of communication between buildings [...] electric cranes and transfer tables have adv[...] tages over appliances of the same nature driv[...] by steam and air.

SPECIAL APPLIANCES.

In these, electricity shares a large field wi[...] compressed air. It must be admitted that [...] devices have up to the present time receiv[...] most attention at the hands of the railway m[...] chanic; a fact in large part due to the lack o[...] practical knowledge of the electrical specials [...] and to the greater cheapness of air tools. Wi[...] however, the general introduction of electr[...] shop power plants and the better acquaintance [...] of practical men with the agency, an extensi[...] application of electric labor-saving devices [...] certain to result.

Flexibility.—The extension of a shop build[...] or the tool equipment under the shafting syst[...] is generally a matter of much difficulty, and t[...] attempt to add to such a plant often results [...] inconvenient crowding of the tools or to [...] overloading or complication of the shafting sy[...] tem, a fact which fully accounts for the e[...] tremely poor efficiency sometimes quoted f[...] shafting transmission. In an electric system, o[...] the other hand, great flexibility in extension [...] secured, as new buildings may be placed in a[...] convenient position, and additions made to th[...] driving system without affecting the intermediat[...] links.

Speed Control.—The ease of speed contr[...] between wide limits of certain types of electric [...] motors is a valuable feature and will result i[...] more frequently securing a greater adaptability [...] of the tool to the work than is possible where a [...] change in speed involves stopping the tool and [...] shifting belts and gearing.

Increase in Output.—This constitutes, in the opinion of your committee, the chief claim of electric transmission to the attention of shop managers, and follows from the previously mentioned facts, as, by the use of electric handling devices, the tool is quickly served with its work and the product placed in the most favorable position for operating upon and idle time cut down, and, by independent driving, the capacity is increased by reason of the perfect control of speed possible.

*From a report by a committee to the Master Mechanics Convention, held at Saratoga, N.Y., July, 1900.