TALKS WITH WOOD-WORKERS.

SOME fine results are said to be obtained in the ornamental working of wood by the use of an ingraining machine brought forward by a Pennsylvania inventor. The mechanism is described as a hollow cylinder, ten and one-half feet in circumference, to which the grain of a piece of oak of the width of the cylinder has been transferred, this grain being covered with a soft cement which sinks into the depressions, and in these about 200,000 bits of metal, like type, are set, above this being placed a small, smooth steel cylinder, adjustible to different heights; between the two cylinders both revolving, a piece of birch, poplar, bass, spruce or maple may be passed, which comes out with the grain of the oak transferred to it, after which it has passed between two other steel cylinders, one revolving in a trough containing a liquid consisting of oil, coloring matter, and another ingredient -- not yet disclosed -- used as a "filter." After being treated in this manner the wood is subjected to processes of polishing and varnishing, and when finished presents the appearance of choice quartered oak.

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Several references have been made in these monthly talks to various features of moulding machines. A writer in the Tradesman furnishes the following contribution on the subject, which will be appreciated, I think, by wood-workers: Manufacturers of moulding machines often make a great mistake in recommending too high speed for their machines and by this means defeat their own honest intentions. While it is safe to assume that the average modern moulder is sufficiently strong so far as weight and strength are concerned to stand any reasonable amount of speed under certain conditions, still the conditions under which the moulding machine is subjected are different from the ordinary planing machine. With the ordinary planer the knives are all of the same width and project an equal distance beyond the point of the cylinder, so that there is no good reason why they may not be kept at all times in good running balance, hence the cylinders of the planer may be run to 4,000 revolutions per minute or even more, with but little vibration. Such is not the case with the moulding machine. There is no point to speak of upon the cutting edge of a moulding knife, where the distance from the point of the cutter head to the edge of the knife is the same, consequently if two knives are used, which is generally the case with nearly all standard mouldings, the utmost care should be manifested in not only the perfect corresponding shape upon the cutting edge, but also in the exact length of the bevel and thickness; even then, when both may show exactly the same weight upon the balancing scale, a very slight imperfection in the bevel when run at high speed will cause a vibration that will plainly manifest itself upon the surface of the moulding. For this reason it is not good practice to speed a moulding machine as fast in proportion as a planer, no matter how heavy and strong it may be. In this respect the manufacturers do not seem to realize the difficulties which even the best and most experienced moulding machine operators have to contend with, especially where sectional cutters are used, which is becoming a common practice in nearly all mills, and where a number of different shapes are used to form the moulding. The difficulty in combining them so as to form a perfect running balance is greater than where two perfect shapes are used.

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The demand for maple flooring has become something enormous (that is, it was when there was a demand for anything, and probably will be again). A few years ago since planing mills turned it out to order only. Now immense factories, so far at least as our neighbors to the south are concerned, turn out little else. Special machines are used to produce it, among them those that bore it for the nails and those that tongue and groove the ends. In the words of a lumber paper: "Maple flooring has come to be regarded as the thing indispensible in most public buildings, and is largely used in private dwellings. Such an extent has the demand reached that the large dealers are obliged to make contracts for millions of feet far in advance of requirment, the same as is done with pine or any other wood of extensive sale and consumption in the building trades and manufacturing."

JAS.

SHAFTING.*

I NEED offer no apology for bringing a subject of this kind before an Association of Stationary Engineers, for wherever you find a stationary engine you will also find more or less shafting; and if any other excuse were required it will be found in the fact that questions on shafting are quite frequently found in the Question Box at our meetings.

It may be, however, that there are some present who think that as engineers they are not expected to have anything to do with shafting. They may argue something like this. "Our employers expect too much from us; they look for us to wheel in coal, fire two or three boilers, wheel out the ashes, attend our engines and a score of other jobs, as well as find tools for the whole establishment; and it would be just as well not to know anything about shafting, or we would be expected to attend to that too." In answer to such I would say, that it is not often that a man loses his situation by being too well posted, and in this world of changes one never knows when he may be called on to make use of the knowledge he possesses.

It is of the greatest importance that all shafting should be properly proportioned and correctly put up, as it not uncommonly happens that great loss of power and much annoyance results from carelessness or ignorance, and a plant that is otherwise of the best, rendered unsatisfactory.

The first question the engineer has to decide is what size or strength of shaft he requires to do a certain amount of work, and in doing so he must bear in mind that a small increase in diameter will give a large increase in strength. It is not an uncommon thing to hear a man say that such a size ought to do the work, but to be on the safe side will put in a size larger, not knowing that he is adding a much larger factor of safety than he had any idea of. The strength of a shaft varies as the cube of its diameter varies. Let us assume that 1" shaft will safely drive at a given speed four horse-power; a 2" shaft will drive as much more as the cube of its diameter in excess of the cube 1. The cube of 1" is $1 \times 1 \times 1 = 1$. The cube 2" is $2 \times 2 \times 2 = 8$. The cube of 3 is $3 \times 3 \times 3 = 27$ and the cube of 4 is $4 \times 4 \times 4 = 64$.

Now we assume that the 1" shaft drives 4 H. P., the 2" shaft drives as much more as the cube of its diameter is in excess of the cube 1; the cube of 2 is 8, therefore its power compared with the 1" shaft driving 4 H. P., is $2 \times 2 \times 2 = 8 \times 4 = 32$ H. P., and comparing the 3" shaft with the 1", the cube of 3" is 27 and the power of the 1" is 4 H.P.—$4 \times 27 = 108$ H.P. It must be borne in mind that these figures are comparative and are given to show the rapid increase of strength in a small increase of size, for if we were to use a 3" shaft instead of a 2" we would have 108 H. P. instead of 32 H. P.

Another fact we must not lose sight of is, that the power a shaft will drive is in direct proportion to its speed. If a shaft drives 4 H. P. at 100 revolutions per minute, at 200 revolutions it will drive 8, and at 300 it will drive 12 H. P. The higher the speed of the shaft the smaller the diameter of the shaft to drive a given H. P. Then there is another important consideration in selecting a proper size for a shaft—as they are inclined to bend and also to twist we must take into account the weight of the pulleys and the distance they are from the bearings and whether the strain of the belts is down or the reverse. The bending of a shaft as well as the torsion contributes towards its liability to break, but the bending is the most likely to cause it. The bending also causes a considerable loss in power as well as the liability of belts running to one side of the pulleys. It follows therefore a shaft loaded with pulleys must have a greater number of bearings and the pulleys placed as near the bearings as possible.

To put up a larger line of shafting than is necessary, is objectionable for two reasons, 1st it costs more to put it up, and 2nd it costs more to run it after it is up. The extra weight of the long shaft as well as the larger circumference which has to move through a greater distance will add materially to the friction. There is one other fact I would notice before leaving this part of the subject, and that is, that the second and third lines may be smaller than the main driver. The reason of this obvious, for the first line has not only its own machinery to drive but also the second and third lines with the machinery driven from them.

To make this clear, I have prepared a diagram which I believe will make it plain to everyone. We will call it a mill or factory, and we assume that the machinery in it requires 100 H. P. to drive. The machinery on the first floor requires 45 H. P., that on the second, 30 H. P., and on the third, 25 H. P. Now the shaft A and B are practically one shaft, being coupled together by the gear; so are C and D, and E and F, but while practically one shaft, A has to transmit 100 H. P., while B only transmits 45 H. P., therefore B may be smaller than A. B having absorbed 45 H. P., it follows that C has only to transmit 55 H. P., therefore C may be smaller than A. The machinery on the first and second floors has now absorbed 75 H. P., leaving only 25 H. P. for the third floor, therefore the shaft E and F may be smaller than C.

The same argument will hold good with the shafts B, D, and F. If the machinery which they drive was equally distributed from end to end, then the ends furthest from the motive power might be smaller because they would have less power to transmit, but in practice the disadvantage would be greater than any gain that would be derived from so doing.

I will now give one or two rules to determine the size required to drive a given H. P.

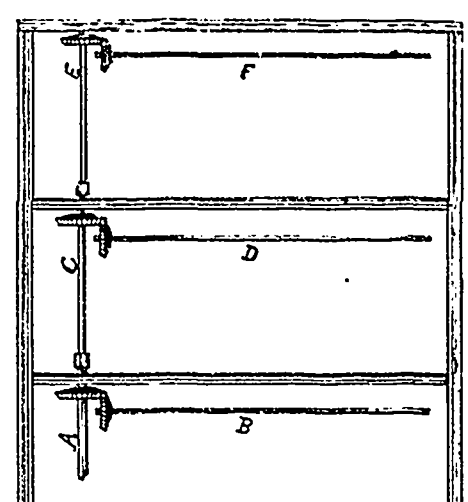
To find the power a shaft will transmit, cube the diameter and multiply by the number of revolutions per minute, and by two if it is the first line from the engine, and by three if it is the second and divide by 100

The crank shaft being the first or prime mover, what power will a 2" shaft transmit as a second mover running at 300 revolutions per minute? $2 \times 2 \times 2 = 8 \times 300 = 2400 \times 2 = 4{,}800 \div 100$ 48 H. P. If steel add 30 per cent. If this shaft was to be used as a second line then it would be: $2 \times 2 \times 2 = 8 \times 300 = 2400 \times 3 = 7200 \div 100 = 72$ H. P. Where the power required is known and number of revolutions is given and the size of shaft is wanted, proceed as follows: What diameter of shaft is required as a prime mover to transmit 75 H. P. at 175 revolutions? $75 \times 100 = 7.500 \div 175 = 42.86 \div 2 = 21.43$. The cube root of 21.43 is 2.75, (2.7776) the diameter required.

The same problem with the shaft used as a second line, would be: $75 \times 100 = 7500 \div 175 = 42.86 \div 3 = 14.28$. The cube root of *14.28 is 2.42 (2.4261) the diameter required.*

Having got the size we want, the next thing is to get it put up and it is right here where many failures and mistakes are made. There is perhaps no part of the plan which should be more carefully looked after than the proper lining of the shafting because it is a never-ending source of annoyance if out of line. The rules governing the putting up of shafting are few and very simple

1st, Be sure that your shaft is exactly at right angles with the engine pulley; 2nd, see that it is dead level; and 3rd, be sure that it is as straight as a line can make it. The same rules should



be observed with intermediate and counter-shafts, they must be parallel with main shaft. All shafts carrying pulleys must be level; a shaft driven with gear from a horizontal shaft must be at right angles with it but may be run at any angle from the horizontal, and the same if driven from a perpendicular—in this case the driven shaft must be level, but may be run in any direction. If the building is likely to settle the adjustable hanger should be used but where there is no danger of settling, stationary bearings should be used, especially for dynamos and all heavy machines which ought to be a rigid as possible.

I do not think it advisable to give any rule for the distance at which bearings should be set, as circumstances vary in almost every case, but would state that for a a 3" shaft the distance should never be more than 15 feet, and for a 2" shaft not more than 11 or 12 feet. These distances in both cases are for shafts without pulleys.

We have stated that second and third lines of shafting may be smaller than the first, but this applies only where they run at the same or at higher speed, and does not apply where the speed is reduced for the purpose of driving heavy and slow speed machinery or lifting heavy weights. *Let us try to make it plain.* Let us assume we have a weight of 33,000 lbs. to lift and a one H. P. engine to lift it with; we can raise the weight one foot high in one minute, but if our weight is ten times as heavy, or 330,000 lbs. it is evident that to lift this with the same engine it can only be done by a sacrifice of time, or in other words a reduction of speed (bear in mind that to lift a weight greater than the motive power can only be done at a sacrifice of time). Now what are we going to do? Our weight is 330,000 lbs., and our engine is only 1 10th the power required to lift it. It is evident we must construct a system of reducing gear. We will assume that we require three reductions—the first reduction will be from the engine to the first shaft, and so on until we reach the third or last shaft which supports the weight. Now the nearer we get to the weight the stronger must the shafting be, and the same with the gear, because as each shaft is reduced in speed it is capable of transmitting less power, and therefore must be increased in size.

Precisely the same principle is clearly shown in the use of the lever—a man can lift a heavy weight with a lever, but it is always at a sacrifice of time or speed. It is also well understood that the end of the lever on which the man rests may be very much smaller than the end which rests on the fulcrum, because on it rests the whole weight.

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* Paper read before Toronto No. 1, C. A. S. E. by Geo. Gilchrist.