POWER AND ITS TRANSMISSION.

IN order to save considerable time and trouble in searching for information with regard to the transmission of power, says the *Millers' Journal*, the following data have been collected from a mass of irrevalent matter The reader will be able to find at a glance what he wants to know in order to be able to makee acurate calculations.

BELTING.

Belting is daily coming more and more into use, and it is safe to say that at least 95 per cent. of the power is transmitted by it, while in Europe the greater part of the power is transmitted by cog-wheels.

THE POWER OF BELTS

is derived from the friction between the surface of the belt and the pulley, and is governed by the same laws as in friction between flat surfaces. The friction increases regularly with the pressure, and the more elastic the surface the greater the friction. The only fault to be found with the system of belting is that a portion of the revolutions of the motor are lost. The number of revolutions lost vary with the load as it changes. Ordinary belts will safely sustain a working tension of 45 pounds per inch in width.

WIDTH OF BELT, ETC.

The rule to determine the width of belt and size of pulley required to transmit a given horse-power is easily found. Since a horse-power is 33,000 pounds raised one foot high per minute, we must adjust the width and velocity of belts so as to effect the required result. Thus, if a belt moves with a velocity of 733 feet per minute, a belt five inches in width will transmit five horse power, provided the effective tension is 45 pounds per inch. If the velocity be increased up to 1 466 feet per minute the same belt with the same tension will transmit ten horse-power, so that a five inch belt applied to a five foot pulley making 120 revolutions per minute would transmit ten horse-power when the effective tension is 225 pounds.

By taking the actual tension of the belt and multiplying it by the actual velocity, we get what may be called the indicated horse power of the belt, which corresponds to the indicated horse-power of the engine. By measuring the actual power transmitted, by a dynamometer, rules may be based upon the amount of belt surface in contact with the pulley.

For practical purposes, velocity and power to resist tension are the only available elements of calculation.

Actual tension, adhesion, friction, &c., can all be varied at will and form no certain dependence for calculation. It may, however, be adopted as a rule that the adhersion and capability of belts to transmit power is in the ratio of their relative lengths and breadths. A belt double the length or breadth of another under the same circumstances will transmit more than double the power, and for this reason it is desirable to use long belts. By doubling the velocity of the same belt its effective capability for transmitting power is also doubled.

Belts which run vertically should always be drawn tight, or the weight may prevent its adhering closely to the lower pulley, but in all other cases they should be moderately slack.

In order to obtain the greatest amount of power from belts the pulleys should be covered with leather, and more power can be obtained from the grain or hair side to the pulley than the flesh side, as the belt adheres more closely.

The most effectual remedy for preventing belts from running to one side of the pulley, would be to find out first if the face of the pulley is straight, if not to straighten it. In some cases the shafts may not be in line. The remedy in this case would be to slacken up the hanger bolts and drive the hangers out or in, as the case may be, until both ends of the shaft become parallel. This can be determined by getting the centres of the shafts at both ends by means of a long strip of board.

TIGHTENERS

should be placed as close to the large or driving pulley as circumstances will permit, as the loss of power in the use of a tightener is equal to that required to bend the belt and carry the tightening pulley; therefore, there is a greater loss of power by placing it near the small pulley, as the belt will be bent more than near the large one.

Belts always run to the highest side of the pulley, because of centrifugal force, and that part of the belt nearest to the highest part of the rounded pulley is more rapidly drawn, because the circumference of the pulley is greater at that point.

LENGTH OF BELTS.

The rule for finding the length of a belt desired is to add the diameter of the pulleys together, devide the sums by 2, and multiply the quotient by 3¼, add the product to twice the distance between the centres of the shafts, and the sum will be the length required.

WIDTH OF BELT.

The rule for finding the width of belt to transmit a given horse-power is to multiply 36,000 by the number of horse power; multiply the speed of the belt in feet per minute by one-half the length in inches of belt in contact with smaller pulley; divide the first product by the second, the quotient will be the required width in inches.

HORSE-POWER OF A BELT.

Following is the rule for calculating the number of horse-power a belt will transmit, its velocity and number of inches in contact with the small pulley being given. Divide the number of square inches in contact with the pulley by 2, multiply this quotient by the velocity of the belt in feet per minute, divide this amount by 32 000 and the quotient will be the number of horse-power the belt will transmit.

To ascertain the horse-power which belts will transmit, multiply the width of the belt by the diameter of the pulley (in inches), by revolutions of the pulley (per minute), by the number in the following table corresponding to the pull the belt can exert per inch of width. Example: 10 inch single horizontal belt, 36-inch pulley, 200 revolutions, pull taken at 50 lbs.

10"x36"x200x0 0001–28.8 horse-power

The pulls which belts 1 inch will transmit are as follows:

Single horizontal belts	50 lbs.
Double	100 "
Single vertical	40 "
Double	60 "
Quarter-twist single belts	25 "
" double	40 "

Pull exerted by belt 1 inch wide, in pounds.	Horse-power—Pulley 1 inch diameter, one revolution per minute, belt 1 inch wide.
10	.00008
15	.00012
20	.00016
25	.00020
30	00024
35	.00028
40	,00032
45	.00036
50	.00040
55	.00044
60	.00048
65	.00052
70	.00056
75	.00060
80	.00064
85	.00068
90	.00072
95	.00076
100	.00080

HOW TO PUT ON A BELT.

Never try to put on a belt on the pulley in motion Always place it first on the loose pulley, or the pulley at rest, and then run it on the pulley in motion.

ADHESION.

Adhesion of the belt with the pulley is found to exist most perfectly between surfaces that are coated with some semi-liquid. Castor oil has been found to have an excellent effect, and it is claimed that a belt three inches wide impregnated with it will transmit as much power as a 4 inch belt without it, and, besides this, rats will avoid castor oil, hence they will not touch a belt with it on.

Printer's ink has been recommended as a means of preventing belts from slipping. Neatsfoot oil, with a little resin, has been found very useful when a belt becomes hard and dry, but castor oil and glycerine are the best for this purpose.

The power required to bend the belt from a straight line and cause it to lap tightly around the pulley would not at first sight appear to be worth considering, but it will be found that where the belts are thick and rigid this item becomes an important one, and it becomes advisable to lessen it. The thicker the belt the more difficult it is to bend it It is therefore more economical to use broad, thin belts than narrow, thick ones, as it has been found that the resistance of the belt to bending is inversely as the diameter of the pulley, large pulleys being more economical in this respect

LACING A BELT.

There are many ways of making a lace joint or sewing a belt The following has been recommended: Suppose the belt to be 8 inches wide, punch holes not larger than 3 16th, beginning at ⅜ inch from the edge and one half inch from the end, making the holes ¾ of an inch apart from centre to centre. This will give eleven holes. Let the holes in either end of the belt be exactly opposite to each other. Now place the belt in position with a lace thong, not to exceed in width the diameter of the holes cut from a thin side of lace leather. Begin at one edge to sew your belt exactly in the same manner as you would lace your shoe, drawing the ends well together at each stitch. Having worked across the belt, secure the last edge with one end of the thong by sewing over and over, and repeat the operation to the place of beginning, securing the ends of your thong by inserting them in leading holes made by an awl.

POWER OF BELTS.

The smoother the surface of the belt and the pulley, the more friction is obtained. The following ingredients when mixed can be put on the inside of a belt, when the inside is put next to the pulley. They will be found to have a very good effect, as they will keep the surfaces cool, smooth and moist: 5 lbs of common tallow, 1 lb of yellow wax, 2 lbs of common chalk, 1 lb of blacklead and 1 lb of resin Dissolve together by gentle heat; put upon the belt when slightly warm. Keep well stirred while applying it; use a little at a time and frequently. It is better, however, to put the hair side next the pulley for power and grip, but the belt will not last so long.

THE COST OF SUPPLYING ELECTRIC POWER.

THERE is nothing in the electrical business that is exciting more interest at the present time than the transmission of power over electrical wires. In the city of Boston there are over a dozen elevators now using this system, to say nothing of the different places where power is used to run printing presses, and for all kinds of manufacturing purposes. The power is now in practical use, not only in this city, but in Providence, Woonsocket, Pawtucket, Worcester, Portland and other places. Who can see the end of the advantages to be derived from this great improvement in transmitting power? Every floor of high buildings in cities can have power of the most economical kind. We publish below an estimate by the Sprague Railway and Electric Motor Company, of the cost of supplying this system using the Sprague motors run from electric light or power stations. The figures are of interest to any one interested in the cost of power.

Estimate of the Cost of supplying Electric power from a Station already Established, and the profits Therefrom.

We will assume the station to be already in running order, and furnishing lights for both day and night service, and to be of the capacity of one hundred and fifty-horse power.

Owing to the intermittent use of power by consumers, so we l known to steam power producers, if the power delivered to any one consumer be limited to say, ten-horse power, at least double the output of the engine, or three hundred-horse power, could be sold from this plant, were it transmitted by the ordinary methods, and as the loss in transmission by wire is not nearly as great as by belting and shafting, especially where the distance exceeds one hundred feet, the same law of general average is truer in the case of electric power than in that of steam,—we therefore could base our calculations upon the well known practice of all power producers,—but to avoid any possibility of dispute, we will assume that only fifty per cent. above the actual output of the engine can be sold.

INVESTMENT.

Additional wires, structures and switches	$2,500 00

RUNNING EXPENSES.

Coal, (cheap fuel, three tons screenings to one ton Cumberland) four pounds per horse power per hour, ten hours per day	$2,200 00
Oil, additional	100 00
Moter inspector (can also attend to lamp inspection).	500 00
Water, incidentals, etc	200 00
Other expenses which cannot be specified	500 00
Total.	$3,500 00

PROFITS.

Income from 225-horse power at $125.00 per horse power per annum	$28 125 00
Less expenses per annum	3,500 00
Profits	$24,625 00
Income from 225-horse power at $100.00 per annum.	$22,500 00
Less expenses per annum	3,500 00
Profits	$19,000 00

Where the station is only running during the night, the profits are the same as above, after first deducting the additional expense for engineer and fireman for day service, but as all incandescent plants to be a complete success must be run during the day, and as such has been the experience of so many plants, it hardly needs mention, and the additional profit from the day lighting will, in almost every instance, more than cover the extra expense.

SMALLER PLANTS.

In small cities and towns, where not more than 100-horse power can be sold within a reasonable time, it is often considered advisable for the company to own the motors, and as the intermittent use in such small plants will not be so great, we will assume that only the output of the engine can be sold; the investments and profits therefrom, would be as follows:—

INVESTMENT.

Motors, various sizes, up to 10-horse power and aggregating 100 horse power	$10,000 00
Wires, structures and switches	1,000 00
Total investment	$11,000 00

RUNNING EXPENSES.

Coal (as above)	$1,550 00
Oil (additional)	50 00
Inspector (lamp inspector for small plant can attend to motor inspection)	500 00
Water incidentals, etc	150 00
Other expenses which cannot be specified	500 00
Total expences	$2,750,00

PROFITS.

Income from 100-horse power at $125,00 per horse power per annum	$12,500 00
Less expenses	2,750 00
Net profit	$9,750 00
Income from 100 horse power at $100.00 per horse power per annum	$10,000 00
Less expenses	2 750 00
Net profit	$7,250 00

The figures as given above for expenses are not theoretical but are founded upon the actual expenses of running electric light and motor stations, using Armington and Sims engines and the Jarvis setting for boilers.—*Boston Journal of Commerce.*