PRINCIPLES OF SHOP MANIPULATION FOR ENGINEERING APPRENTICES.

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BELTS FOR TRANSMITTING POWER.

The traction of belts upon pulleys, like that of locomotive wheels upon railways, being incapable of demonstration except by experience, hindred for a long time the introduction of belts as a means of transmitting motion and power. I mention motion separately because with many kinds of machinery that involve high speed, such as wood machines, the transmission of rapid movement must be considered it well as power, and it is only by means of belts that such high speeds may be communicated from one shaft to another ; so that at least in practice, belts alone are at this time employed for high speeds.

The first principle I will point out in regard to belts, distinguishing them from shafts as a means of transmitting power, is that the power is communicated by means of tensile instead of torsional strain, the power during its transmission being represented in the difference of tension between the driving and the slack sides of the belts.

In the case of shafts, their length, or the distance to which they may be extended in transmitting power, is limited by torsional deflection, and as this torsional strain is avoided with belts, we may conclude that, unless there are other disqualifying conditions, belts are better than shafts for transmitting power through long distances.

Belts suffer resistance from the air and from the friction in the bearings of supporting pulleys, which are necessary in long horizontal belts. With these exceptions they are capable of moving at a high rate of speed and transmitting power without appreciable loss.

Following this proposition into modern engineering practice, we find how experience has gradually conformed to what these properties in belts would suggest ; wire and other ropes with a diminished cross section to avoid air friction, and allowed to droop in low curves to avoid supporting pulleys, are now commonly employed for transmitting power through long distances. This system has been very successfully carried out in Germany and America, in some cases for distributing power in large manufacturing establishments.

Belts, among which are included all flexible bands, do not afford the facilities for taking off power at differents points that shafts do, but have advantages in transmitting power to portable machinery, or, in other words, when the power is to be taken off at movable points, as in the case of travelling cranes, hoists, and so on.

An interesting example in the use of belts for communicating power to movable machinery is furnished in the travelling cranes of Mr. Ramsbottom, in the shops of the London and North-Western Railway, at Crewe, and at other works, where powerful travelling cranes receive both the lifting and traversing power by means of a cotton rope not more than 1in. in diameter, which moves at a high velocity, the motion being reduced by means of tangent wheels and gearing to attain the force required in lifting heavy loads. In looking at this mechanism, those who had not their conceptions based on a true knowledge of power and the relations between power and speed, would see, in the effect of this small cotton rope, something marvellous.

Considered as means for transmitting power, the contrast as to advantages and disadvantages lies especially between belts and gearing instead of between belts and shafts. It is true in extreme cases, such as that cited at Crewe, or in conveying water power from inaccessible places through long distances, and so on, the comparison lies between belts and shafts, but for ordinary practice, in three cases out four, the problem as to mechanism for conveying power is between belts and gearing.

If experience in the use of belts was thorough, as it is in the case of gearing, and if the quality of belts did not form an important part in the estimates, there would not be much difficulty in determiuing where belts should be employed and where gearing would be preferable.

Belts are continually taking the place of gearing, even in cases where they have been until very recently thought inadmissible ; at least one of the largest rolling mills in Pittsburg, Pennsylvania, except a singlr pair of spur wheels as the last movers at each train of rolls, is driven by belts throughout.

Leaving out the matter of a positive relative movement between shafts, which belts as a means of transmitting power cannot insure, there are the following conditions that must be considered in determining whether belts or other means should be employed in transmitting power :

1. The distance to which the power must be carried. 2. The speed at which tha transmitting machinery must move. 3. The course or direction of transmission, whether in straight lines or at angles. 4. Durability and the cost of construction. 5. The loss of power during transmission. 6. Noise, vibration, and jar.

In every case where there can be a question as to whether gearing shafts or belts will be the best means of transmitting power, the several conditions named will furnish a solution if properly investigated. Speed, noise, or angles may become determinative conditions, and are such in a large number of cases ; first cost and loss of power are generally secondary conditions.

Applying these tests to cases where belts, shafts, or wheels may be employed, and carefully considering the special conditions of any case, the apprentice willsoon find himself in possession of knowledge to guide him in his own plans and enable him to judge of the correctness of examples that come under his notice.

It is never enough to know that any piece of work is generally constructed in some particular manner, or that such a proposition is generally accepted as being correct ; nothing is learned, in the true sense, until the reasons for it are understood, and it is by no means sufficient to know from observation alone that belts are best for high speeds, that gearing is best to form angles in transmitting powor, and that belts produce less jar and noise ; the reasons for these things and the principles that lie at the bottom must be reached before it can be assumed that tne subject is understood.

(To be continued.)

WATCH-MAKING IN SWITZERLAND.

Horological industry has grown to extraordinary dimensions in Switzerland, and the *Journal de Genève* supplies the following statistics :—In the four cantons of Neuchâtel, Berne, Vaud, and Geneva more than 25,200 men and 12,700 women are employed in the various branches of the business, of whom 30,600 belong to Neuchâtel and Berne. The trade has grown of late most rapidly in Berne, where at present half a million of common watches are produced annually, their value being set down at an average of forty francs each, making a total of £800,000. In the canton of Geneva the number made annually does not exceed 150,000, but nearly all of them are in gold cases, and ornamental, so that the total value is about the same as the half million produced in Berne. Vaud makes about the same number as Geneva ; the movements are generally well finished, but many of them are exported without cases ; the value is considered to average about 55 francs, giving a total of £320,000. The same canton also produces about 80,000 musical boxes of the value of £80,000. One-half of the whole of the watches made in Switzerland are produced in Neuchâtel, and, in value, 35 per cent. of the whole, or £1,400,000 per annum. The total number and value of watches produced is given as follows :—Switzerland, 1,600,000 of the approximative value of £3,520,000 ; France, 300,000, value £660,300 ; England, 200,000 value £640,000 ; and the United States of America, 100,000 valued at £300,000. It will be observed from the above figures that while the average value of Swiss watches is about 4s. 6d. each those of France reach an average of 44s., those of England 68s., and those of America 60s. The fine balance-spring of a watch is said to furnish the most remarkable example of the increase of the value of a raw material by the application of skill. It would be curious to know the cost of the materials employed to produce the 2,200,000 watches of the four countries quoted, of the approximate value of £4,800,000. Still more curious would be the relative value of a first-rate chronometer, and the materials with which it is produced.

Galignani states that the French Stamp-office has just purchased the secret of the composition of an ink absolutely indelible, and which resists the strength of all known reagents. Owing to that discovery, it will be able to put an end to the numerous frauds which are constantly committed to the prejudice of the Treasury, and which consist in restoring to stamped paper already used its original purity. The annual loss to the revenue on that head is calculated at 600,000f. in the Department of the Seine alone.