NOTES ON BELTING.

Tests of Leather, Rubber, Cotton and Other Belts.

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FOR transmission of power by belting various materials are used. Among the most important are: Leather, rubber and cotton belts.

The material considered most favorable for belting is probably leather. It is very efficient and wears well, but is more expensive than rubber or cotton. In certain situations where it would be exposed to moisture, great heat, etc., its efficiency and durability are reduced.

Another weakness is that it must necessarily consist of short strips of about five feet in length, joined in various ways, which will be noticed later. The belt is therefore subject to failure in as many places as there are joints. Some methods, however, make the joints almost as strong as the solid leather, but the presence of the joint may cause the belt to fail, not from tension, but from a tendency to wear or crack at that point.

The best belts are made from oak-tanned ox-hide, the strongest part of the hide being the back. The belt can be made in long strips by taking a wide disc of leather and cutting it in a spiral direction. The strip thus cut is stretched taut and rubbed to make it straight. From a disc 4 ft. 9 in. wide a strip over 100 feet long of 2 inch belt can be made. If greater width is desired several strips can be sewn together side by side. A double belt of this kind has been used 75 inches wide and over 150 feet long.

The grain or hair side of the leather is put next the pulley. It would appear at first sight as if this were a mistake, since the grain side is the smoother and would therefore give less friction.

Mr. Arthur Archard, of Geneva, in a paper before the Institute of Mechanical Engineers, 1881, says:

"If the belt is wide, a partial vacuum is produced between the belt and the rim of the pulley, by the aid of an adequate velocity which causes the atmospheric pressure to press the belt close against the pulley; an adhesion is thereby produced which is totally independent of friction, and enables the tensions to be considerably reduced." This is very important, because the less the tension on the belt, the less will be the friction on bearings, and, hence, the greater power derived. A wide, thin belt is therefore better than a narrow, thick one, and this is so not only for the reason that it gives less tension on the belt, but because it also gives greater flexibility.

Mr. D. A. Low, in his Machine Designing, also states that the smooth side is the better "because it gives greater driving power," reasoning probably in the same way as Mr. Achard.

Mr. J. Tullis, of Glasgow, however, states that the belt will last longer if the grain side is out, and that coatings of curriers' dubbin and oil will make the flesh side as smooth as the other. All writers seem to agree that the adhesion of the belt to the pulley depends very little, if any, on friction, and that, therefore, a rough surface is more injurious than useful.

Rubber belting is superior to leather in damp places. The part of the belt that gives it strength is not the rubber, but the cotton framework.

It is made by taking a wide strip of cotton duck and folding it into as many plies as desired, with rubber in between, with a thicker coating of rubber on the outer side.

The rubber is in a liquid state when applied to the cotton, and when the belt is finished it consists of a strong, solid, flexible belt, having the appearance of solid rubber. There is almost no limit to the length that can be made in one piece, so that there is only one joint in any piece of belt in use. Even this can be avoided by ordering an endless belt for special cases. The manufactured product is usually very uniform in quality. Extremes of heat and cold have very little effect on it, and it has very little tendency to slip on the pulley. It should be kept free from all animal oils or grease, as these are injurious to the rubber. Rubber belting seems to be especially adapted for such purposes as elevators, for railways, pulp mills, mines, etc.

Cotton, that is cotton without rubber or any other material, makes an excellent belt. It can be made stronger than leather of the same cross-section, and of great length without joints. It is better than leather in moist places, and is less expensive. It was formerly made in the same way as cotton and rubber belting—that is, by laying one ply of cotton duck on top of another till the desired thickness was attained, and then sewing the whole together The more modern method is to make the whole thickness together at one operation, each ply being interwoven with the one next to it. The process of manufacture is rather complicated, but this does not make the belt expensive.

An improvement on the plain cotton belt is made by soaking it in a mixture of red lead and linseed oil. This process has the same effect as it has in preserving wood. The cotton belt is then more efficient in moist places or in conditions which are found very unfavorable to the use of leather or even rubber. Some modifications of this kind of belt are made by substituting for part of the cotton a woof of hair and other materials. An example of this is the "Camel Brand," tests of which are reported below.

Gutta percha has been used as a substitute for rubber, and has been found to be a good protection to the cotton. A special brand of this, called "Balata Belting," was tested. It is manufactured in England, and has a rather thick coating of gutta percha on the outer side, and thin layers between the layers of cotton, while the side next the pulley is coated with a solution called "Balata."

STRESSES IN BELTS.

Belts are subject to two kinds of stress, viz., tension and bending, but the most serious strain is caused by bending round the pulleys. If the pulleys are small, the only way is to use the most flexible material. This will probably be the cheapest in the long run.

A good rule is given by Lineham in his Mechanical Engineering, viz., the distance from centre to centre of pulleys should not be less than six times the diameter of the larger pulley.

A most important matter is that the edges of the belt should wear well. If the edge is not good it will soon become frayed by contact with the rim of the pulley, and will cause failure of the belt. The best edges that the writer has seen on any belt are on good oak tan leather, and on rubber. The structure of the latter (folding), together with a strong covering of rubber, secures a good, compact edge.

Belts of paper have been made and used in the United States with success. They are very strong and durable if not exposed to moisture, and they stretch very little while at work.

So far nothing has been said with regard to stretch of belts under tension. This will be treated along with the results of the tests.

Creep in belts is due to the belt stretching on the tight side. If the belt stretches easily this is very serious. For every foot of belt that goes on the driver less than a foot goes off and goes on to the follower. If the diameters of the pulleys were equal the driver would make a greater number of revolutions in unit time than the follower would. Hence, if there is much stretch in the belt there is a loss of speed. This loss amounts to 1 per cent. to 3 per cent., depending on the elasticity of the belt; since the tension on the belt is kept as low as possible to prevent too much friction on bearings of the pulleys, the belt that is least extensible at low tensions is the one which is most valuable in this respect.

JOINTS AND FASTENINGS.

Joints form the weak feature of belts, so far as tensile strength and wear are concerned, especially in the case of leather belting. They are of two kinds, (a) permanent, (b) temporary.

Permanent joints take many different forms. In leather belting the most common is the laced joint (Fig. 1.) A lap-joint splice is made and cemented together; then two or three rows of rawhide lacing is put in. The holes for the lacing are not punched, but two sharp cuts are made for each stitch. The cuts should lie diagonally so as to injure the longitudinal fibres as little as possible.

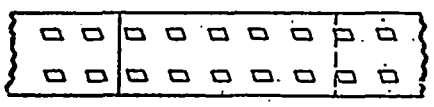

FIG. 1.

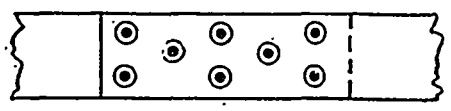

FIG. 2.

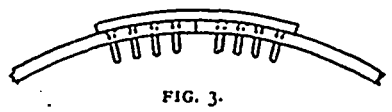

FIG. 3.

FIG. 4.

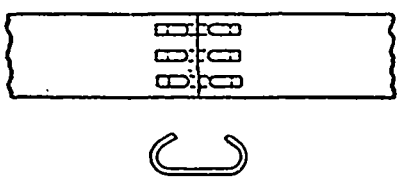

FIG. 5.

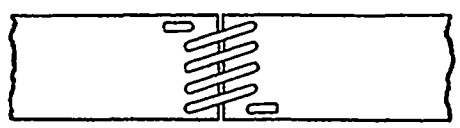

FIG. 6.

FIG. 7.

FIG. 8.

FIG. 9.

Copper riveting is used as a substitute for lacing, the belt being spliced, as before, and a number of rivets inserted (Fig. 2.) This joint shows a tendency to break across a row of rivets, and is only about two-thirds the strength of the solid belt.

Harris metal plate fastener (Fig. 3) consists of a slightly curved plate, same width as the belt, with a number of spikes. The belt is cut with square ends, and the spikes are driven first through one piece and then the other. As the plate is curved and the spikes are perpendicular to it, they take a good firm grip on the leather. The spikes are clinched after connection.

In Lagrelle's fastener (Fig. 4) the ends of the belt are cut square and bent up. Strips of steel or iron are run through the holes cut for the purpose, each strip having two eyes to hold pins. These pins run through strips at each end, and form a wide link. In fasteners such as this the strain is distributed over the width of the belt, and there is also not the same tendency to cut through in front of the holes as in many other kinds.

TEMPORARY FASTENINGS.

The fastener shown in the accompanying sketch (Fig. 5) consists of a curved strip of iron. The ends of the belt are cut square and holes are made to receive the fastenings, which are inserted and hammered flat.

Laced Joints. There are many forms of laced joints. The simplest is shown in Fig. 6.

Fig. 7 is the same joint as Fig. 6, but double laced.

Fig. 8 is a double laced joint with only one strand in each hole.

In the joint shown in Fig. 9 the holes are staggered, there is only one strand in each hole, and the strands do not cross on each other.

These are the commonest forms. Fig. 6 has hardly enough lacing; Fig. 7 has twice as much lacing as Fig. 6, but concentrates all the stress on a single row of holes. Joints like Fig. 8 and Fig. 9 give about the greatest possible strength of lacing.

The holes for the lacing are usually round punched. Awl holes are not so good. D. A. Low, Machine Designing, says that the holes should be oval punched, and should have the long diameter parallel to the edges of the belt. And on the face next the pulley the lacing should be as nearly parallel to the edge as