Power Transmission in Textile Mills

By Charles L. Hubbard

The greatest admissible distance between bearings for shafts of varying size, limiting the deflection to $^1/_{80}$-inch per foot of length, under the conditions of strain noted above, are given in Tables IV and V, which are for turned steel and cold-rolled steel respectively.

Ex. A turned line-shaft is to transmit 120 horse-power at a speed of 400 revolutions per minute. For a certain portion of its length it is free from pulleys, being used for transmission only. What size of shaft should be used and what is the limiting distance between bearings for that portion carrying no pulleys?

$$120 \div 4 = 30$$

Referring to Table II under turned lined-shafts, we find this number calls for a 3-inch shaft, and Table IV gives the limiting distance between bearing for a shaft of this size, used for transmission only, as 11.8 feet.

TABLE IV. (Turned Steel Shafting). Limiting distance between bearings. Torsional strain only. No bending strain except from own weight.

DIAM. OF SHAFT	DISTANCE BETWEEN BEARINGS	DIAM OF SHAFT	DISTANCE BETWEEN BEARINGS	DIAM. OF SHAFT.	DISTANCE BETWEEN BEARINGS	DIAM OF SHAFT.	DISTANCE BETWEEN BEARINGS
1½	7.5	2½	10.5	3½	13.1	5	16.6
1⅝	7.9	2⅝	10.8	3⅝	13.4	5¼	17.2
1¾	8.3	2¾	11.2	3¾	13.7	5½	17.6
1⅞	8.6	2⅞	11.5	3⅞	14.1	5¾	18.3
2	9.	3	11.8	4	14.4	6	18.8
2⅛	9.4	3⅛	12.2	4¼	14.9	6½	19.8
2¼	9.8	3¼	12.5	4½	15.5	7	20.8
2⅜	10.1	3⅜	12.8	4¾	16.1	7½	21.8

SHAFT AND PULLEY ARRANGEMENTS.

While the laying out of a system of shafting for a large mill is the work of an engineer, there are often cases where it is desirable to make changes or extensions without securing expert advice. The following suggestions, together with rules and tables, will be found of use in work of this kind.

Two common arrangements for laying out a line of shafting are shown in Figs. 17 and 18. If the line is very long there will be an inclination for it to twist at the extreme end, especially if much power is taken off. This condition may be greatly improved by arranging to supply the power at the center of the line as shown in Fig. 17.

For shorter lines, the power may be supplied at one end, as in Fig. 18 if more convenient. The general arrangements of bearings and couplings are shown in the illustrations. The head-shafts should be in a single piece of as short a span as possible, with the couplings outside the main bearings.

Line-shafts extend in both directions in Fig. 17 and in one direction in Fig. 18, reducing in size as power is delivered to the various counter-shafts or machines connected with them. Sometimes a friction clutch cut-off coupling is used instead of the rigid coupling shown in the cuts. This enables the line-shaft to be disconnected from the head-shaft without stopping the prime mover, which is often of much importance in case of accident or minor repairs, especially in the double arrangement shown in Fig. 17.

Receiving and transmitting pulleys should be placed as close to the bearings as possible, framing short "headers" between the main tie-beams for this purpose when necessary. If this cannot be done conveniently the span between bearings may be increased and the size of shaft enlarged according to Table III.

The transverse or bending strain on a shaft may sometimes be considerably reduced by arranging the pulleys so as to neutralize the belt pull, a scheme sometimes possible for doing this is illustrated in Fig. 19.

TABLE V. (Cold-Rolled Shafting). Limiting distance between bearings. Torsional strain only. No bending strain except from own weight.

DIAM. OF SHAFT.	DISTANCE BETWEEN BEARINGS	DIAM. OF SHAFT.	DISTANCE BETWEEN BEARINGS	DIAM. OF SHAFT.	DISTANCE BETWEEN BEARINGS	DIAM. OF SHAFT.	DISTANCE BETWEEN BEARINGS
1½	7.5	2⅜	10.2	3¼	12.6	4¼	15.1
1⅝	7.9	2½	10.6	3⅜	13.	4½	15.7
1¾	8.4	2⅝	11.	3½	13.3	4¾	16.3
1⅞	8.7	2¾	11.3	3⅝	13.6	5	16.8
2	9.1	2⅞	11.6	3¾	13.9		
2⅛	9.5	3	12.	3⅞	14.2		
2¼	9.9	3⅛	12.3	4	14.5		

COUPLINGS.

In line shafting the coupling of the lengths together is a matter of much importance, as all errors of alignment are likely to increase the friction at the bearings, and, if sufficiently pronounced, to fracture the shaft under continued operation.

The strength of the coupling should equal that of the shaft so far as resistance to torsion is concerned. If solid pulleys are to be used at any point the coupling should be one that is easily disconnected. With split pulleys, which are now widely used, this requirement is not necessary and the shafting may be coupled up permanently by means of rigid couplings, which tend to maintain an accurate alignment under continuous use.

A typical flange or plate coupling is shown in Fig. 20. This is made in medium and heavy patterns, according to the service required. In textile mills, where the load is more nearly uniform, the stresses in the couplings are not so great as where heavy loads are thrown on suddenly, as in rolling mills.

With the coupling shown in Fig. 20 the end of the shafts to be joined are keyed to the flanges, which are accurately bored and faced in a lathe, and then bolted together.

An important requirement in the design of any coupling

THE CONSTRUCTION OF WEAVES.

(Continued from previous page.)

Fig. 501. Twill ground, 24x24. Risers added.

Fig. 502. Twill ground, 16x16. Risers added and removed.

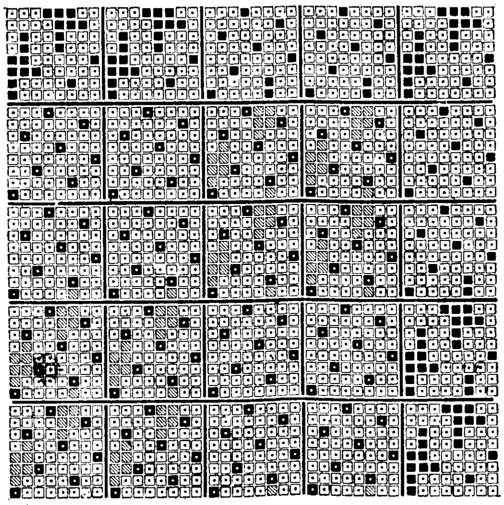

FIG. 504.

Fig. 503. Satin ground, 30x30. Risers added.

Fig. 504. Satin ground, 32x32. Risers added.

Fig. 505. Satin ground, 18x18. Risers removed.

Fig. 506. Satin ground, 18x18. Risers added.

Fig. 507. Satin ground, 28x28. Risers removed.

is the absence of projections which may catch in the clothing of anyone coming near them. The bolts in the coupling shown are protected by lips or extensions at the outer edge of the flanges. In some makes of couplings of this type the flanges are recessed in order to secure more accurate alignment when erected.

When shafting for a considerable piece of work is made up at the shop the flanges are forced on by hydraulic pressure, after which they are refaced, thus ensuring more perfect results.

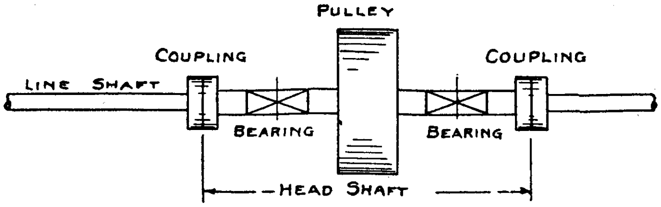

FIG. 17.

Forged flanged couplings are made by upsetting the ends of the shafts to be joined, so as to form discs or flanges of the proper size, which are turned up in line with the axis of the shaft in a lathe and bolted together like those shown in Fig. 20.

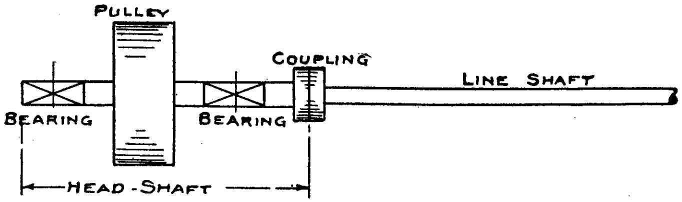

FIG. 18.

A side-clamp coupling for medium duty is shown in Fig. 21. This is made in halves, with recesses for the bolts which clamp the coupling around the shaft. It is about four diameters in length and can be removed without disturbing the shaft. Couplings of this form are sometimes provided with a smooth outer casing which completely covers the bolt heads.

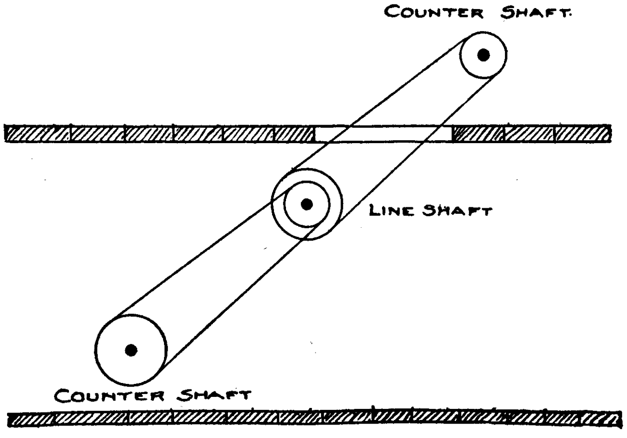

FIG. 19.

The double cone coupling, adapted to medium loads, and shown in Fig. 22, is somewhat more complicated than those previously shown, but has the advantage of being easily removable and allows for some variation in the diameter of the shafts upon which it is placed.

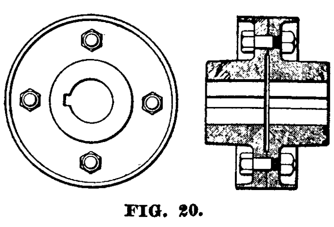

FIG. 20.

This coupling consists of an outer sleeve finished to receive two cone bushings bored to the diameter of the shaft and drawn together by three bolts, as shown. The effect of this is to clamp the ends of the shafts to the sleeve by means of the bushings. As a precaution against slipping, and to provide additional strength, a key is run the entire length.

An internal clamp coupling is shown in Fig. 23. This consists of a single casting, combining an inner clamp with an outer casing, between which are inserted lengthwise, taper screws bearing the entire length. The clamps are divided across the centre of the coupling as indicated, thus making the grip upon the ends of the two shafts independent. This type of coupling is light, simple in construction and easily removed, and like the one previously described, is provided with a key to prevent any possibility of the shaft slipping in the clamp.

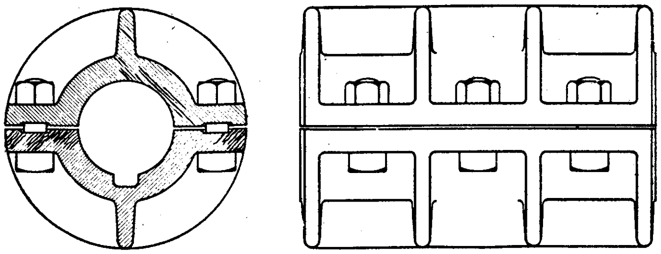

FIG. 21.

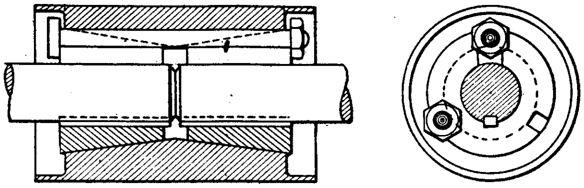

FIG. 22.