Making Silk Throwing Profitable

A careful study made to determine the right speeds at which various silk yarns should be thrown, produced an easy method of saving a great deal of money

By NELSON B. GARDEN

The silk throwsters in the Scranton-Wilkes-Barre district found that something would have to be done to keep their final statements from appearing in the red. Since 24 hour operation has been used in all the plants for some time, the overhead already has been cut to a minimum. The operating expense is made up largely of labor and power, and of these, the labor cost is fairly well fixed. This leaves the item of power the most promising point of attack to effect a saving in costs.

Figures obtained from a number of plants showed that the profits, if any, were in the neighborhood of 16 to 20 cents per pound and that the power cost varied from 10 to 16 cents per pound, running even higher for some periods of operation. Hence, a reduction of 4 cents or 5 cents per pound for power would mean an increase of 25% in profits. In many cases, this would turn a loss to a profit.

It is obvious to anyone visiting a throwing plant, that only a small percentage of the power consumed is required for the ultimate step of putting in the twist in the spinning operation. However, it was startling to learn from an investigation of actual operation as described in the following tests, just where the power was consumed and that the difference in power required when ends were tied up in a frame, and when they were not, was too small to be determined. In other words, it requires a negligible amount of actual power to put in the twist. The power is consumed in other places.

A certain well known mill therefore made very careful tests of operating conditions to determine the best possible speed to run the spindles, with the lowest possible consumption of power and still produce a yarn in which the twist would not vary and the quality would be high.

The purpose of this article is to show how these tests were made, the remarkable results obtained, and to give an easy method of determining the proper speed to accomplish the above named results.

Three standard types of machines were selected for tests and the experiments were carried out in plants with machines in regular operation. Those selected were individually driven by electric motors, because this enabled the use of meters for obtaining the information desired. This is a simple but accurate means of making the tests, and the results apply equally well to machines driven by belts from a line shaft.

The instruments required were an ammeter, voltmeter, wattmeter and tachometer. These will enable obtaining similar information in any plant. Special equipment beyond the range of standard throwing apparatus, was used to extend the scope of these experiments, i. e., odd sized pulleys, whorls and bobbins.

Although the tests were carried out primarily with the idea of studying the power question, the items of labor, quality of product and maintenance of equipment are so tied in with the power consumption that it was impossible to avoid giving consideration to these in order to arrive at the correct answer regarding power.

The first step taken was to study the driving elements that are responsible for the spindle speed. Starting at the source of power (line shaft or motor), the power was traced to the pulley, then to the belt and finally to the whorl. By means of the tachometer, the speed of the driving element was determined, then the circumferential speed of the pulley, the speed of the belt surface, and finally the R.P.M. of the spindle. These readings were translated into theoretical spindle speeds, assuming that there was no slip at any point, and plotted in Figures I and II.

In Figure I the curves are for an 18,000 R.P.M. motor driving a 13/16″ whorl through various sized pulleys. The spindle speed in R.P.M. is plotted against pulley size in inches diameter.

Curve A shows the theoretical spindle speed if the 18,000 revolutions of the motor were transmitted to the spindle without slip.

Curve B shows the theoretical spindle speed for the actual motor speed, which is less than 18,000 R. P. M., and falls off as the load increases with larger pulleys and the resulting higher spindle speeds.

Curve C is the theoretical spindle speed if

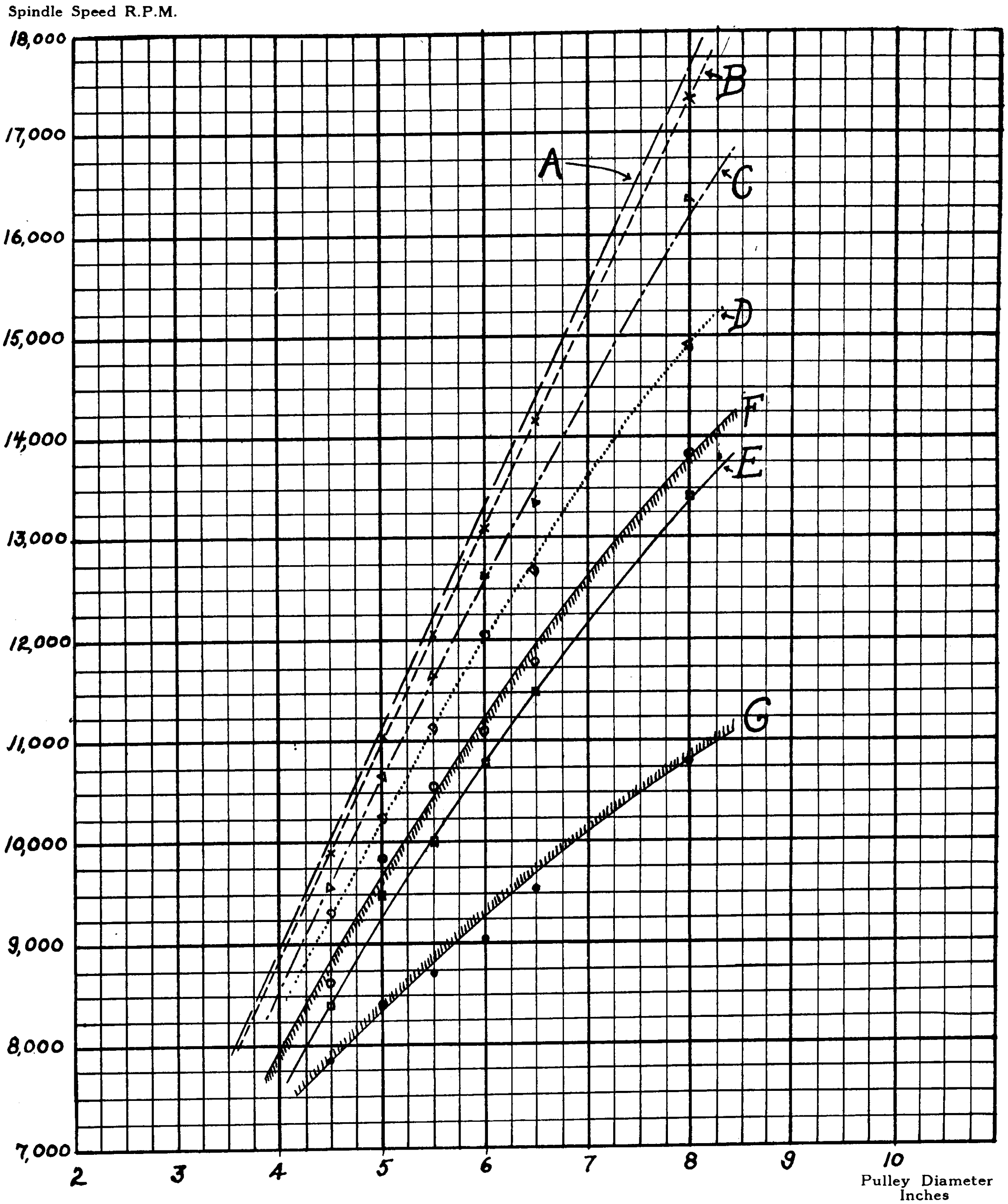

Fig. 1. Curves showing where speed losses occur between the source of power and a spindle with 13/16″ whorl.

the belt speed were transmitted to the spindle without slip. Hence, the difference between B and C is the slip between the belt and the motor pulley.

Curve D is the actual spindle speed without bobbins and the difference between Curve D and Curve C is the speed loss between the whorl and spindle belt for this condition. This curve is interesting inasmuch as it enables determining the speed loss due to the weight and air friction of the bobbin, by comparing it with the next Curve E.

Curve E is the actual spindle speed in operation, and the difference between C and E is the slip between the belt and the whorl.

To more clearly explain these curves, take the conditions where a 6″ pulley is used. From Curve A, the spindle speed should be 13,300 R.P.M., but the motor slowed down so that the spindle would only rotate at 13,100 R.P.M. But the belt slips on the pulley of the motor and the loss here reduces the spindle speed to 12,600 R.P.M. obtained from Curve C. The final spindle speed is 10,800 R.P.M., as shown by Curve E, so that the loss between the belt and the whorl is the difference between C and E, or 1800 R.P.M. for a 6″ pulley.

Although these losses cannot be entirely eliminated, they can be held at a minimum, and they must be controlled so that they are consistent and hence produce a uniform twist that will meet the requirements of the trade.

For a very thorough analysis, the items listed below would have to be considered. Only the more important are discussed here, as they are deemed sufficient.

(a) Tension and wear of belt.
(b) Weight and dimensions of bobbins.
(c) Amount of silk on bobbins.
(d) Tension of spindle spring.
(e) Lubrication.
(f) Whorl diameter.

The influence of the weight and dimensions of the bobbin is best shown by Curve D of Figure I which was obtained with the bobbins removed. The difference between D and E is the loss due to the windage and extra weight of the bobbins. For the 6″ pulley considered above, the speed loss of the spindles due to this is 1200 R.P.M.

The tension of the spindle spring plays an important part and Curve G shows what may be expected if the tension is put at 18 ounces while Curve F is for spring tension around 9 ounces. The normal Curve E was obtained with spring tension adjusted between 12 and 14 ounces.

There is an influence of the whorl size beyond that of the regular difference due to the ratio of diameters. The greater the whorl diameter, the larger the arc in contact with the belt and the less speed loss there will be between belt and spindle. As the question of whorl diameter usually produces considerable discussion, Figure II is given to show what may be expected from a 1″ whorl operating under the same conditions as the 13/16″ whorl.

In Figure II Curve A is the theoretical spindle speed on the assumption of 18,000 R. P. M. being transmitted to the spindle without loss.

Curve B is the theoretical spindle speed from the actual R.P.M. of the pulley.

Curve C is the belt speed so that the difference between B and C is the slip between the pulley and the belt.

Curve D is the actual spindle speed and the slip between the spindle and the belt is shown by the difference between C and D.

It is interesting to note that the speed drop between the pulley and the spindle with the 1″ whorl is only from 11,750 to 10,800 R.P.M., while for the 13/16″ whorl the drop is from 13,100 to 10,800 R.P.M., and that the pulley need only be 6⅝″ in diameter instead of 7⅜″, as would be assumed from the difference in whorl diameter.

Although each plant must develop the figures for its own cost, the results of these tests proved that with the present types of machines in use, a 1″ whorl is the smallest that can be justified. If the pulley size is adjusted, the speed may be brought up as high with a smaller whorl and the output thus maintained. At the same time, there will be less slip in the belting, and less loss from claims and rejections, as the finished yarn is more even and of better quality.

The adjustments of belt and spring tension also need not be so accurately watched as their influence becomes less with the larger whorl.

Curves of this type have proven very valuable to throwsters from many angles, and are important factors in deciding the purchase and layout of equipment.

Power Tests

During the runs when the speed readings were taken, values were also obtained from the electric meters which had been installed in the line feeding the motor. The results of these have been put in a form for ready comparison and plotted in the curves of Figure III.

Curve A is the power required in watts per spindle which must be supplied to the electric motor or from a line shaft, for the different values of spindle speed.

Curve B is the power consumed per spindle at the spindle. This was obtained by blocking first 5 spindles away from the belt, then 10, then 15, etc., and noting the difference in the power input.

The difference between A and B is the power lost in the machine. The power represented by B is that required to overcome the windage of the bobbin and friction of the spindle, because it was found that the difference in power requirements could not be noted when the ends were tied in and when they were not.

Curves C and D of Figure III are the same as A and B, except that the bobbins had been removed in this case.

The difference between B and D shows the amount of power consumed by the air friction of the bobbin and the increased fric-

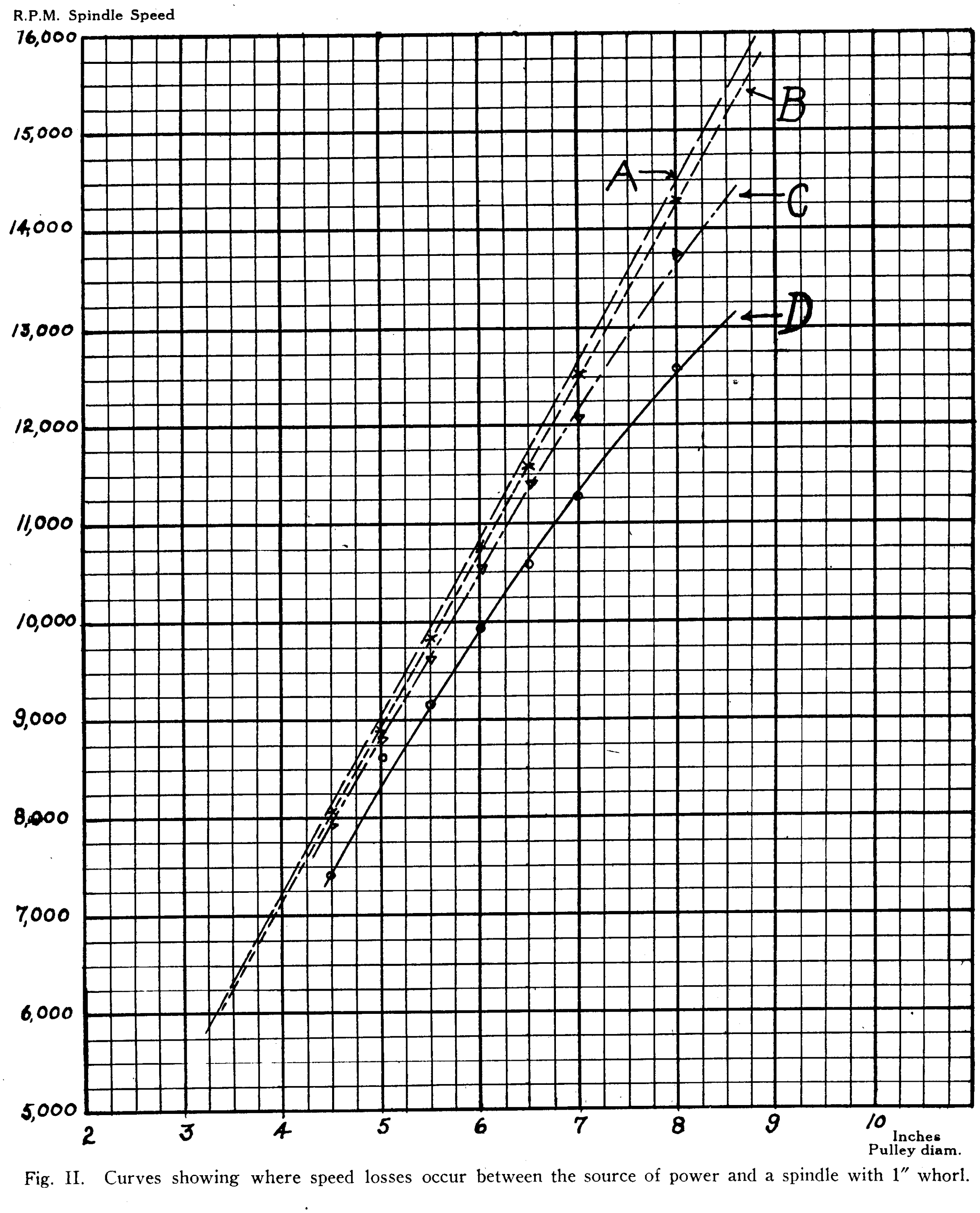

Fig. II. Curves showing where speed losses occur between the source of power and a spindle with 1″ whorl.

tion load due to the weight of the bobbin.

A vast amount of information may be worked out from such curves. One or two sample calculations may be of interest.

At 8000 R.P.M. it only requires 3 watts to drive the spindle and bobbin at the spindle, but 10.5 watts musts be supplied to the motor. This means that 70% of the energy is lost in transmission to the spindle. At 12,000 R.P.M., 11 watts are required at the spindle and 20.8 watts must be supplied to the motor. Under these conditions, the operation shows that only 50% of the energy is lost in reaching the spindle. It might be concluded that the power

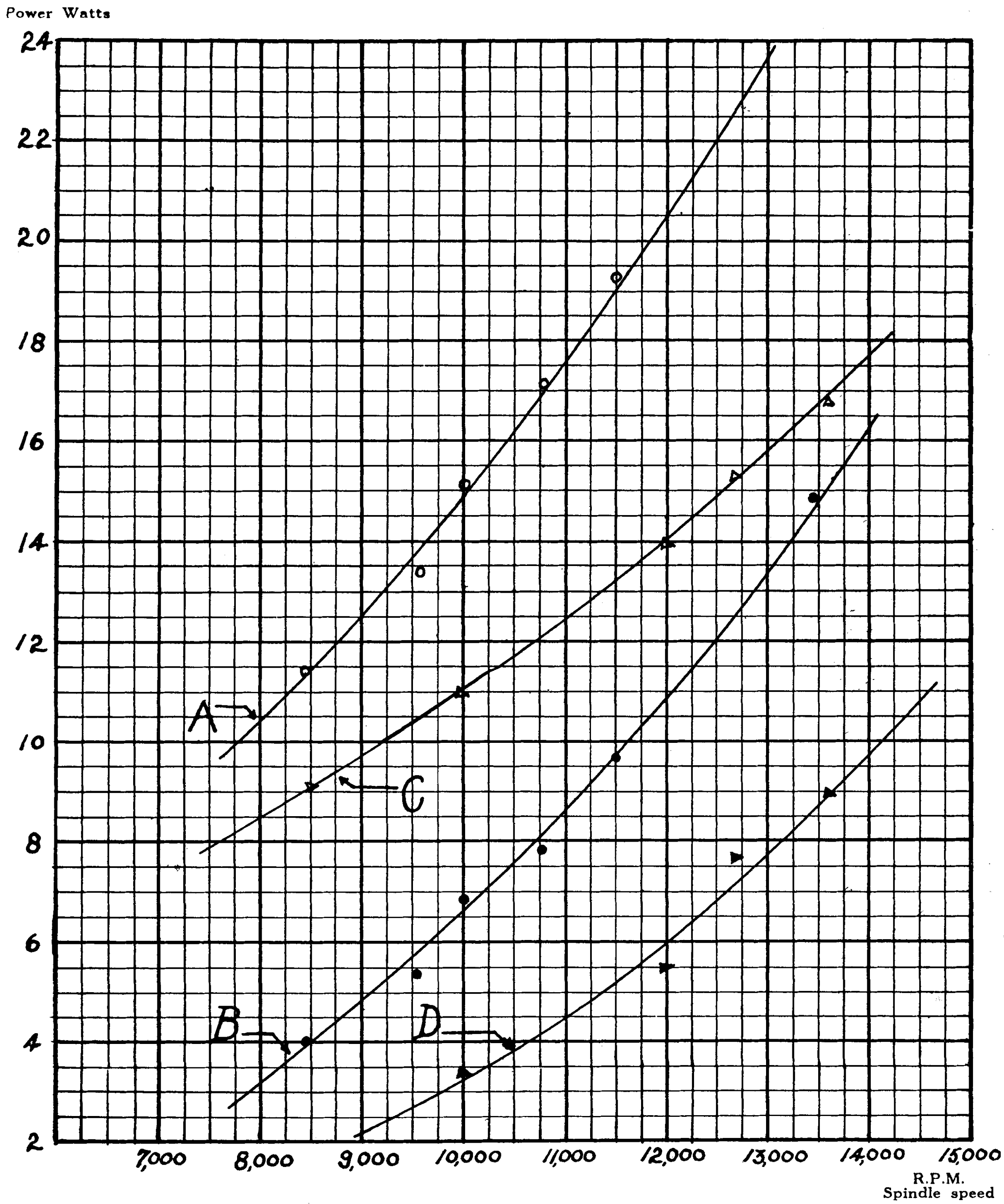

Fig. III. Curves showing power requirements to drive a spindle with and without bobbin at various speeds, both at the spindle and at the source of power.

conditions have improved, but from the viewpoint of production, the figures are very different.

The production increase from 8,000 R.P.M. to 12,000 R.P.M. amounts to 50%, whereas the power input has increased from 10.5 watts to 20.8 watts, or 100%. This means that the power cost, over a period of time for the larger production is doubled, and the output only increased half, so that the resulting power cost per pound of output is 33% higher.

It may be startling to some, to find that for this change in speed, the power increase at the spindle is from 3 watts to 11 watts, or nearly 300%.

As it may be of interest to have a table of the approximate power consumption for the various yarns, the following is submitted. The figures are for speeds around 1000 R.P.M., and should be increased or decreased for speeds above or below this.

Yarn Spun		*Turns per inch*	*Kwh. per lb.*
2 Thd.		70	11.0
3 "		65	7.3
4 "	Georgette	70	5.5
4 "	Crepe	65	5.0
5 "		65	4.2
6 "		60	3.3
10 "		55	1.9
11 "		55	1.7
12 "		55	1.6

Conclusion

From the tests made, it was definitely shown that for economical silk throwing it is necessary to maintain a very close check on the machines and equipment to assure that they not only are operating at maximum efficiency, but also, and more important, to assure that they run consistently so that losses from poor yarn are eliminated.

A general rule cannot be set up for the proper speed at which to operate the spindles, because the power labor and overhead costs must be taken into consideration for each individual plant and each thread being thrown.

Spindle speeds of 20,000 R.P.M. are being used in foreign countries and many throwsters hastily conclude that it would be of advantage to adopt such operation in their plant. But from these tests, they can readily see that it might increase their cost tremendously.

The adoption of these curves in some plants and the basing of operations upon the results shown, has enabled several throwing mills to effect savings which run into many thousands of dollars per year, and has, in some instances, turned losses into profits.

Any silk throwing plant, therefore, that uses such charts based on facts, can save many dollars per year, getting greater production, higher quality, satisfy their customers, reduce their kicks, and make more money with practically no effort, nor expenditure for new machinery, for additional labor and equipment.