"Straight Line" Textile Calculations

By Samuel S. Dale

It follows that the cotton No. is found by dividing the constant (1000) by the grains per 120 yards. 1000 ÷ 25 = 40, cotton No. 1000 (grains) ÷ 40 (cotton No.) = 25 grains per 120 yards.

Below will be found the formulas for reducing yarn numbers from one basis to another:

Runs. (1600-Yard Lengths per Pound).

Used for carded woolen yarn. As the runs indicate the number of 100-yard lengths per ounce, the run system is practically identical with the yard per ounce system used in England for silk.

Runs × 1.905 = Cotton No.
Runs × 2 6/7 = Worsted No.
Runs × 5 = West of England No.
Runs × 5⅓ = Linen No.
Runs × 6¼ = Yorkshire No.
Runs × 1600 = Yards per pound.
Runs × 3.22 = Metric No.
2790 ÷ Runs = Denier No.
160 ÷ Runs = Dram No.
525 ÷ Runs = Grains per 120 yds.
437½ ÷ Runs = Grains per 100 yds.
218¾ ÷ Runs = Grains per 50 yds.
109⅜ ÷ Runs = Grains per 25 yds.
87½ ÷ Runs = Grains per 20 yds.
9 ÷ Runs = Jute No.

Cotton Count. (840-Yard Lengths per Pound).

The world's standard for cotton yarn. Also used for spun silk.

Cotton No. × .525 = Runs.
Cotton No. × 1.5 = Worsted No.
Cotton No. × 2⅝ = West of Eng. No.
Cotton No. × 2.8 = Linen No.
Cotton No. × 3.28 = Yorkshire No.
Cotton No. × 840 = Yards per pound.
Cotton No. × 1.693 = Metric No.
5315 ÷ Cotton No. = Denier No.
305 ÷ Cotton No. = Dram No.
1000 ÷ Cotton No. = Grains per 120 yds.
833⅓ ÷ Cotton No. = Grains per 100 yds.
416⅔ ÷ Cotton No. = Grains per 50 yds.
208⅓ ÷ Cotton No. = Grains per 25 yds.
166⅔ ÷ Cotton No. = Grains per 20 yds.
17 1/7 ÷ Cotton No. = Jute No.

Worsted Count. (560-Yard Lengths per Pound).

Used for worsted yarn.

Worsted No. × .35 = Runs.
Worsted No. × ⅔ = Cotton No.
Worsted No. × 1¾ = West of Eng. No.
Worsted No. × 1.8⅔ = Linen No.
Worsted No. × 2 3/16 = Yorkshire No.
Worsted No. × 560 = Yards per lb.
Worsted No. × 1.129 = Metric No.
7972 ÷ Worsted No. = Denier No.
457 ÷ Worsted No. = Dram No.
1500 ÷ Worsted No. = Grains per 120 yds
1250 ÷ Worsted No. = Grains per 100 yds.
625 ÷ Worsted No. = Grains per 50 yds.
312 1/2 ÷ Worsted No. = Grains per 25 yds.
250 ÷ Worsted No. = Grains per 20 yds.
25 5/7 ÷ Worsted No. = Jute No.

West of England Count. (320-Yard Lengths per Pound).

Used for carded woolen yarn in the west of England.

West of Eng. No. ÷ 5 = Runs.
West of Eng. No. × .20 = Runs.
West of Eng. No. × .381 = Cotton No.
West of Eng. No. × .571 = Worsted No.
West of Eng. No. × 1.07 = Linen No.
West of Eng. No. × 1.25 = Yorkshire No.
West of Eng. No. × 320 = Yards per lb.
West of Eng. No. × .645 = Metric No.
13,951 ÷ West of Eng. No. = Denier No.
800 ÷ West of Eng. No. = Dram No.
2,565 ÷ West of Eng. No. = Grains per 120 yds.
2,187 ÷ West of Eng. No. = Grains per 100 yds.
1,094 ÷ West of Eng. No. = Grains per 50 yds.
547 ÷ West of Eng. No. = Grains per 25 yds.
437½ ÷ West of Eng. No. = Grains per 20 yds.
45 ÷ West of Eng. No. = Jute No.

Linen Count. (300-Yard Lengths per Pound).

The world's standard for linen and hemp yarn. Used in the Philadelphia district for woolen yarn and there called the "cut" system.

Linen No. × .19 = Runs.
Linen No. ÷ 5 1/3 = Runs.
Linen No. × .357 = Cotton No.
Linen No. ÷ 2.8 = Cotton No.
Linen No. × .534 = Worsted No.
Linen No. × 15/16 = West of Eng. No.
Linen No. × 1.17 = Yorkshire No.
Linen No. × 300 = Yards per lb.
Linen No. × .605 = Metric No.
14,882 ÷ Linen No. = Denier No.
853 ÷ Linen No. = Dram No.
2,800 ÷ Linen No. = Grains per 120 yds.
2,333 ÷ Linen No. = Grains per 100 yds.
1,167 ÷ Linen No. = Grains per 50 yds.
583 ÷ Linen No. = Grains per 25 yds.
467 ÷ Linen No. = Grains per 20 yds.
48 ÷ Linen No. = Jute No.

Yorkshire Count. (256-Yard Lengths per Pound).

Used in England for carded woolen yarn.

Yorkshire No. × .16 = Runs.
Yorkshire No. × .305 = Cotton No.
Yorkshire No. × .457 = Worsted No.
Yorkshire No. × .8 = West of Eng. No.
Yorkshire No. × .853 = Linen No.
Yorkshire No. × 256 = Yards per lb.
Yorkshire No. × .516 = Metric No.
17,440 ÷ Yorkshire No. = Denier No.
1,000 ÷ Yorkshire No. = Dram No.
3,281 ÷ Yorkshire No. = Grains per 120 yds.
2,734 ÷ Yorkshire No. = Grains per 100 yds.
1,367 ÷ Yorkshire No. = Grains per 50 yds.
684 ÷ Yorkshire No. = Grains per 25 yds.
547 ÷ Yorkshire No. = Grains per 20 yds.
56 ÷ Yorkshire No. = Jute No.

Yards per Pound.

The size of yarn is sometimes indicated by the number of yards per pound.

Yards per lb. ÷ 1600 = Runs.
Yards per lb. ÷ 840 = Cotton No.
Yards per lb. ÷ 560 = Worsted No.
Yards per lb. ÷ 320 = West of Eng. No.
Yards per lb. ÷ 300 = Linen No.
Yards per lb. ÷ 256 = Yorkshire No.
Yards per lb. ÷ 496 = Metric No.
4,464,528 ÷ Yards per lb. = Denier No.
256,000 ÷ Yards per lb. = Dram No.
840,000 ÷ Yards per lb. = Grains per 120 yds.
700,000 ÷ Yards per lb. = Grains per 100 yds.
350,000 ÷ Yards per lb. = Grains per 50 yds.
175,000 ÷ Yards per lb. = Grains per 25 yds.
140,000 ÷ Yards per lb. = Grains per 20 yds.
14,400 ÷ Yards per lb. = Jute No.

Metric Yarn Number (496 Yards per Pound).

This system of numbering (1000-meter lengths per kilogram) is used on the Continent of Europe, principally for carded woolen and worsted yarn.

In France cotton yarn is numbered to indicate the number of 1000-meter lengths per half-kilogram (992 yards per pound, making the French No. equal to one-half of the metric).

Metric No. × .31 = Runs.
Metric No. × .59 = Cotton No.
Metric No. × .886 = Worsted No.
Metric No. × 1.55 = West of Eng. No.
Metric No. × 1.65 = Linen No.

(Continued on following page)

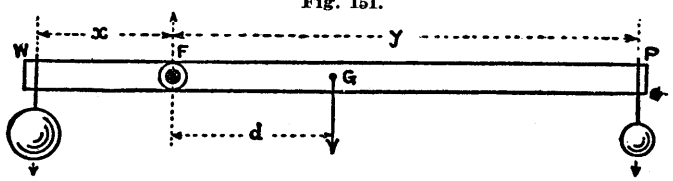
The Mechanics of Textile Processes

By W. Scott Taggart, M. I. Mech. Eng.

In the case of irregular bodies or bodies that are not homogeneous in structure, the center of gravity is found by balancing the body on a knife-edge support or other test, and in many cases by calculation of graphics.

Pulleys and other revolving bodies, no matter how carefully they are made, may have their center of gravity out of the center of the pully. They are said to be out of truth or out of balance and when running are liable to cause serious trouble. All such bodies are carefully balanced by adding

Fig. 151.



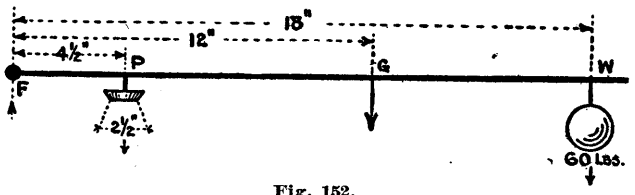


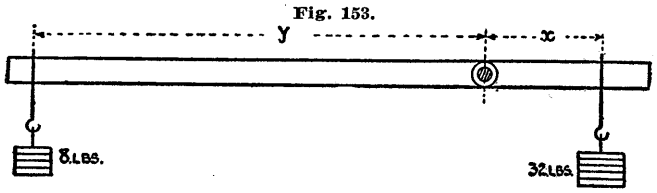
Fig. 152.

or removing portions of the material until they remain at rest in any position when supported on their geometrical center.

If a uniform lever is supported on its center, its weight will act directly over the support and will not affect the balance; but if such a lever is fulcrumed on one side of the center of gravity, the weight of the lever must be taken into account.

Ex. A uniform lever 18 in. long is pivoted at a point 3 in. from one end. From the short arm hangs 36 lbs. How many pounds must be hung from the long arm to obtain equilibrium? The weight of the lever is 6 lbs., Fig. 151.

Fig. 153.



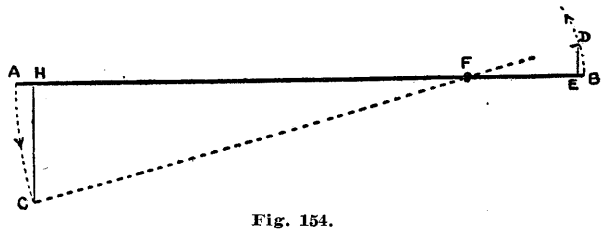


Fig. 154.

The center of gravity is in the center of the lever, so the weight of the lever will act 6 in. from the fulcrum.

Moment of W round F is Wx

Moment of P round F is Py

Moment of G round F is Gd

The moments on either side of the fulcrum must be equal.

$$Py + Gd = Wx$$

$$P15 + (6 \times 6) = 36 \times 3$$

$$P15 + 36 = 108$$

$$P = (72 \div 15) = 4.8 \text{ lbs.}$$

Ex. A safety-valve is 2½ in. dia. A lever 22 in. long is pivoted 4½ in. from the center of the valve and a weight of 60 lbs. is hung 18 in. from the fulcrum. What is the total pressure on the valve, and the pressure per sq. in.? The weight of the lever is 6 lbs. and the center of gravity acts at 12 in. from the fulcrum, Fig. 152.

The pressure P is the unknown quantity.

$$P \times FP = W \times WF + G \times GF$$

$$P \times 4\tfrac{1}{2} = (60 \times 18) + (6 \times 12) = 1152$$

$$P = 1152 \div 4\tfrac{1}{2} = 256 \text{ lbs., total pressure on valve.}$$

Area of valve = 4.9 sq. in.

$256 \div 4.9 = 52.24$ lbs. per sq. in.

MECHANICAL ADVANTAGE

In a previous article the velocity ratio was defined as follows: The movement of the first driver ÷ the movement of the last driver.

This statement may assume a variety of forms all meaning the same thing: the first movement in a given time ÷ the last movement in the same time, or space moved over at driving end ÷ space moved over at finishing end.

It is thus seen that in any given arrangement of driving mechanism it is a simple matter to find how much faster or how much slower the resulting speed or movement is than the starting speed: starting movement ÷ resulting movements = velocity ratio.

This method of comparing movements is applicable to practically all kinds of mechanism and is very often the basis of methods for calculating any advantage we obtain by the use of mechanism. If by the use of some appliance a force of 10 lbs. will enable a person to lift 50 lbs., there is clearly a gain of four-fold, which means that the appliance has enabled the person to move something against a resistance, to lift a load or to exert a force equal to five times the amount of the force applied. This would be termed the *mechanical advantage* of the appliance: force at the terminal end ÷ force at the starting end = mechanical advantage, or load lifted ÷ load applied = mechanical advantage.

This may be illustrated in the case of a simple lever, Fig. 153. If the load applied is 8 lbs. and a weight of 32 lbs. is required to balance it on the other arm in the position shown, then: load lifted ÷ load applied = 4, mechanical advantage.

If instead of a weight being used we applied other forms of force, such as a driving effort, there would be exerted also at the other end a resultant effort or load, so that the effect can be expressed in this form: load ÷ driving effort = 4, mechanical advantage.

Suppose that the lever moves round its fulcrum as in Fig. 154. When the lever has moved from position AB to CD the end A has traversed a portion of a circle AC and the end B has moved in the circular path BD, so that AC ÷ BD = the velocity ratio.

It is easy to show that since AF is four times longer than FB, the arc AC is four times longer than the arc BD, and that therefore the velocity ratio is four, but the usual method is to prove it by drawing CH and DE at right angles to AB and then from the similar triangles show that:

HC ÷ CF = DE ÷ DF. Then:

HC ÷ DE = CF ÷ DF = 4

As HC and DE represent the respective arcs AC and BD, we have

HC ÷ DE = 4, velocity ratio.

"STRAIGHT LINE" TEXTILE CALCULATIONS.

(Continued from previous page)

Metric No. × 1.94 = Yorkshire No.

Metric No. × 496 = Yards per lb.

9,000 ÷ Metric No. = Denier No.

516 ÷ Metric No. = Dram No.

1,693 ÷ Metric No. = Grains per 120 yds.

1,411 ÷ Metric No. = Grains per 100 yds.

706 ÷ Metric No. = Grains per 50 yds.

353 ÷ Metric No. = Grains per 25 yds.

282 ÷ Metric No. = Grains per 20 yds.

29 ÷ Metric No. = Jute No.