# The Mechanics of Textile Processes

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

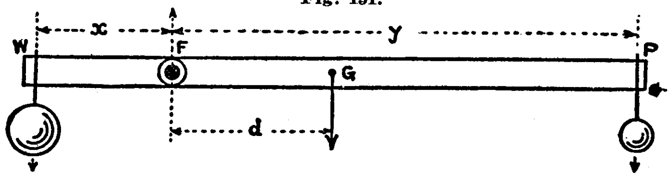


Fig. 151.

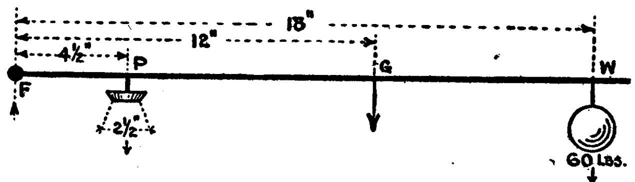


Fig. 152.

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.

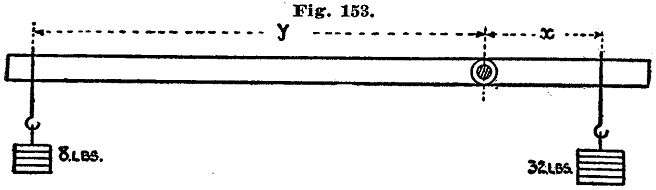


Fig. 153.

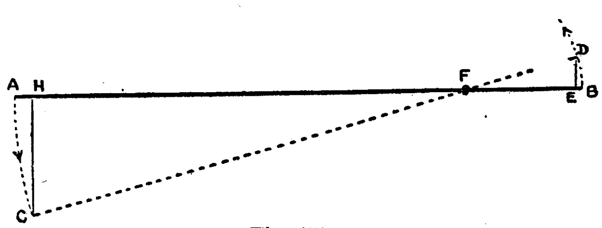


Fig. 154.

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.

$$P \times FP = W \times WF + G \times GF$$
$$P \times 4\tfrac{1}{2} = (60 \times 18) + (6 \times 12) = 1152$$
$$P = 1152 \div 4\tfrac{1}{2} = 256 \text{ lbs., total pressure on valve.}$$
$$\text{Area of valve} = 4.9 \text{ sq. in.}$$
$$256 \div 4.9 = 52.24 \text{ lbs. per sq. in.}$$

### 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:

$HC \div CF = DE \div DF$. Then:

$HC \div DE = CF \div DF = 4$

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

$HC \div DE = 4$, 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.