Mechanics and Engineering.

ELEMENTARY PAPERS FOR YOUNG MECHANICS.

X.—What is a Machine?

Machines have been defined to be "bodies or assemblages of bodies which transmit and modify motion and force."

The word "machine" has, from one point of view, a wide significance, and may be applied to the whole universe or to the minutest insect whose motions and forces are "transmitted and modified" through and by the various parts of its organization.

Animals are "machines," and a study of animal mechanics will well repay any one who has the time and opportunity to investigate the many wonderful combinations of bones and muscles which are to be found in the human frame, or in almost any of the animals whose external appearance we are all familiar with. The word "machine," however, has a more restricted and more commonly accepted meaning, and implies a combination of mechanism and framework, the work of human art, used to "modify and transmit motion and force" for some definite object.

Transmissions of motion and of force are performed by the same elementary parts and at the same time, and are inseperably connected; yet each may be thought out and its laws studied independently of the other. Sometimes machines are made for the express purpose of modifying motion alone, and so long as the parts are strong enough to overcome the friction produced by their own weight, the action of other forces may be immaterial. A clock or timepiece is an illustration of a machine of this kind: the sole object aimed at in its mechanism is to so modify and transmit the motion of a falling weight as to produce regular and uniform motion of the hands across the face of the dial.

In other cases great regularity of motion or velocity is not essential, but the transmission of force is all important. A circular saw may be taken as an illustration of this latter class. So long as the velocity of the cutting edges is great enough to cut cleanly, a little more speed, even a changing speed, will do no harm; and it is of far more importance that there should be force enough to keep the saw going than that it should make an exact number of revolutions each minute or hour.

A machine is composed of several parts, and those several parts are usually classified into two general divisions: 1st, the frame, and 2nd, the mechanism.

"The frame of a machine is a structure which supports the *moving pieces*, and regulates the path or kind of motion of most of them directly."

The frame is usually considered as fixed, and the motions of the moving parts have to be considered in relation to the fixed frame, as well as in relation to each other.

The frame itself may be in motion relatively to another frame, or to the earth; as, for example, the framework of a locomotive engine is fixed and stationary relatively to the shafts and moving parts of the engine, but yet may be in rapid motion relatively to the station platform which it is passing.

As a matter of fact, all our ideas of rest or fixedness, of motion or velocity, are merely relative; and all students of mechanics should endeavor to get clear ideas on this important subject.

The moving parts of a machine are called its "mechanism." Some, again, divide the mechanism into "moving pieces," "connectors," and "bearings."

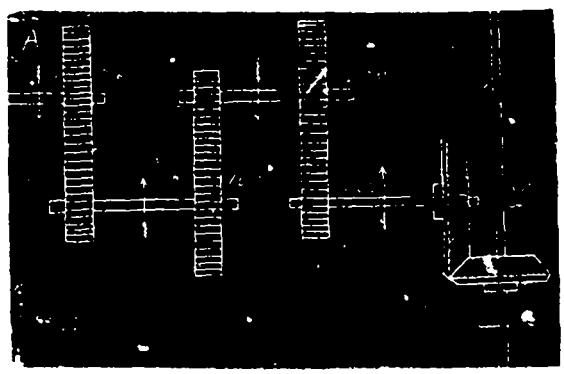
The motions of moving pieces in machinery are, 1st. *Simple rotation*, or *turning* about a fixed axis.

2nd. *Straight translation*, or shifting from one point to another; and in order to maintain this motion for any indefinite time it must be reciprocating; that is, it must be in opposite directions alternately.

3rd. There is a compound of the straight motion and turning, which gives a *helical*, or screw like motion. This also must alternately be in opposite directions, if maintained for an indefinite time.

Ordinary wheel gearing, although involving many intricate problems in regard to the details of the teeth, yet taken as a whole makes one of the simplest forms of moving parts in a machine.

Our illustration shows a series of shafts connected together by toothed wheels. A is the main *driver*, revolving about a fixed axis in the direction of the arrow. It drives a wheel one-half the diameter of the driver, at twice the number of revolutions and in the opposite direction.



Attached to the 2nd shaft is another large wheel driving a smaller one upon a 3rd shaft, and the direction of rotation is again reversed, and the speed increased.

On the 3rd shaft another large wheel drives a smaller one on a 4th shaft with same result. On this 4th shaft one of a pair of wheels of another form is shown driving a wheel on a shaft at right angles—the direction of rotation is shown by the arrow.

Toothed wheels connecting shafts which are parallel to one another are called *spur* wheels.

Those connecting shafts at right angles to each other are called *bevel* wheels, and when both wheels are of the same diameter they are called *mitre* wheels. Two castings off the one pattern will work into each other, and make a pair of mitre wheels, but for bevil wheels there must be a pattern made for each wheel, and one wheel of a pair of bevel wheels will not work correctly with one of any other pair.

When the shafts are at some other angle than a right angle they may be connected by "*skew bevil*" wheels. Our illustration does not show any "frame" connecting the shafts, but it is evident that a frame is necessary in order to hold the wheels in their exact position, or else they could not work.

The points of contact of the shafting with the frame are called *bearings*, and illustrate one of the meanings of that word.