CHAPTER I.

THE DETERMINATION OF VELOCITIES IN MECHANISMS.

In many cases it is desirable to know the velocities of various parts of a machine during operation, as for example the velocity of an engine piston in a given position, or the velocity of a slide valve at the point of cut-off; or it may be desired to study the motion of the cutting tool in a shaper using a quick return motion, or the examination of the advantages of the triplex pump over the simple pump in the matter of uniformity of discharge. Then, again, it is often necessary to determine the turning effect produced on the crank shaft of an engine by the steam pressure on the piston, or to study the advantage in the way of producing uniform motion of placing four cylinders on an automobile engine, etc.

All of these problems may be solved very directly by the determination of the velocities of various points in the machine under consideration, and as such problems are of very frequent occurrence in the experience of the designing engineer, it is desirable that as simple a process as possible be employed in solving them. The problems may be solved by graphical methods most conveniently, as the motions in most machines are so complex that algebraic solutions are too tedious and difficult.

In all machines there is one part which has a known motion, and generally this motion is one of uniform angular velocity about a fixed axis, e.g., the flywheel in an engine, the belt wheel in a shaper, the belt wheel in a stone crusher, etc.

In most cases in machines all parts have plane motion, and in what follows it is to be understood that all parts referred to remain in one plane, unless the contrary is expressly stated. The solutions may in general be applied to non-plane motion with proper modifications.

The method of determining the velocities of parts of machines to be explained here is called the phorograph* method, and gives a convenient graphical method for finding the desired velocities.

THE PHOROGRAPH

Let us consider any body having plane motion, such as the connecting rod of a steam engine. It is well known that any point in this rod can move relatively to any other point in it only at right angles to the line joining these points. Thus

* So named by its discoverer, Professor T. R. Rosebrugh, of the University of Toronto, who gave the method to his students twenty years ago, but so far as the writer knows the method has not been discovered or used elsewhere.