vision that the action of ball bearings is to reverse the direction of friction, inasmuch as the upper surfaces of the balls travel in a reverse direction to their lower. This makes the question appear somewhat more complicated, and inasmuch as it is found that on this latter point there is a difference of opinion, both in theory and practice, by "experts," the writer puts his question, which might otherwise appear trivial.

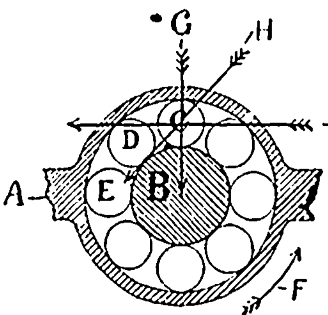


Fig 2

In examining further, let *A*, Fig. 2, represent the hub of pedal, *B* the pedal spindle, *C*, *D* and *E* some of the balls of the bearing; the direction of motion of the driving pedal as compared with the driven spindle is represented, as before shown, by the arrow *F*. The question is in revolving the pedal *A* in direction (with reference to spindle *B*) as indicated by arrow *F*, or left hand, in what direction will the friction produced tend to revolve the spindle *B*, so that we may know whether a right or left-hand thread should be provided in such instances when they occur in mechanical design?

In the ideal ball bearing there would be next to no friction at all, the balls having a true rolling motion against surfaces unimpressable, or so tempered as to have, when impressed, a perfect recoil; the main element of friction we need to consider is that occasioned by the covering of the balls or their paths with a mixture of dust and dried oil, which may be continued till the balls refuse to revolve and the friction becomes intense.

Taking the uppermost ball, *C*, Fig. 2—which when it is carried to the highest point, receives practically most of the pressure—in the ideal state all the force due from the pressure of the foot on the pedal will practically pass in the direction of the line of force indicated by arrow *G* straight to the central point, where it will be most efficient in the propelling of the machine, no force being consumed to compel the balls to revolve; but cover the balls or their paths with a non-elastic yielding substance, and it will pile up against the balls to obstruct their progress, as represented by darkened portions in the paths of ball *C*; force is then called into effect to cause the balls to revolve, and this force must be in a direction opposed to the obstacles. One obstacle is shown between the ball and its case, the other between the ball and its spindle, both having the same effect, namely, obstructing the frictionless turning of the case *A* round its spindle *B*. The upper obstruction between the ball *C* and its case *A* tends to carry the ball *C* round with the case, and the lower obstruction between the ball *C* and its spindle *B* tends to carry the spindle round with the ball in direction indicated by arrow *F*. It is evident, therefore, that the line of direction of the main propelling force has to assume a position somewhat as indicated by arrow *H* to supply the power necessary to overcome the friction of the bearing. In an extreme case of friction, the whole propelling force would assume a direction as indicated by arrow *J*, none being employed to propel the machine as at *G*; but all being employed in a direction tending to turn the spindle *B* in direction of arrow *F*, or left hand. Therefore, in a bicycle, the pedal spindle fitted with a left-hand thread should be on the right-hand side of machine, and also, it appears, there can be no difference in this respect between ball bearings or others. The writer would be pleased if any one differing from him would give another solution for this problem.

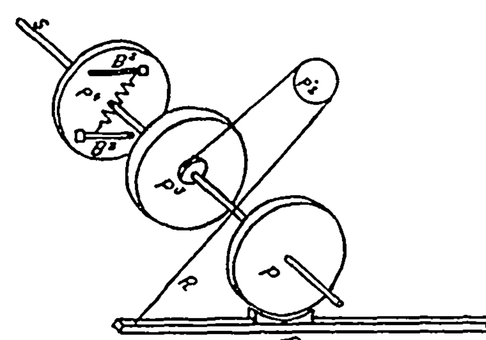
For The Canadian Engineer

ELECTRICITY FROM THE WIND.

(*Concluded.*)

Since writing the paper from which the foregoing abstracts have been compiled, experience has suggested a few changes.

Regarding the working of the system which I have just described, let me say that while at first it proved generally satisfactory, I soon found that owing to its being so complicated, it required much more attention than I had anticipated. Especially was this the case with the dynamo brushes. As the speed was almost constantly changing, I soon found some kind of an automatic arrangement to move the brushes would be required. This necessity added to the complications and turned the course of my experiments in another direction. If you employ a sufficiently strong wheel to allow of a brake being used to check the speed whenever the velocity attempts to rise above that required, a centrifugal ball regulator can be arranged to automatically apply the brake and keep the speed from



becoming abnormal, in the following manner: In figure 3 let *S* represent a shaft to which the dynamo is belted, and upon which a pulley *P* is keyed for receiving a frictional brake *B*, and to the swinging end of the brake let there be attached a rope *R*, passing over a loose pulley P^2 and having its other end fastened to a small pulley made fast to one side of a larger loose pulley P^3, on the shaft *S*. Let the side of pulley P^3, which is opposite the small attached pulley, be hollowed out in such a way as to form a projecting rim or flange from that side of its periphery. On the same shaft *S*, and opposite the concave side of loose pulley P^3, place a tight pulley P^4 (which is represented here removed from P^3 in order to show the mechanism), with two centrifugal frictional balls B^2, so arranged that whenever the velocity of the shaft *S* begins to rise above that required, these frictional balls B^2 grip the inside of the periphery of P^3, and turn the loose pulley P^3. When P^3 turns it pulls on rope *R*, which in turn applies the brake *B*, and checks the speed. At the same time, the centrifugal balls B^2 release the loose pulley P^3, which lets off the brake *B*. I have seen this system in operation, and believe it to be the