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LEVERAGE IN MECHANICS

ONE of the strangest hallucinations in this era of advanced thought in mechanics, as in all other branches of practical science, writes Mr. R. James Abernathey, in the American Miller, is that which clings to leverage as a factor of facilitating work in shops, mills and factories. The attention of the writer has been very forcibly called to this delusion, this relic of past ignorance, this shadow of a darkened period that should be left to oblivion and be forgotten, by a recent controversy with another writer. The writer claimed that if one man, by catching hold of the rim of a 36 inch wheel, could revolve the reel or set of reels with which it was connected, seven or eight times a minute, it would require sixteen men to revolve the same reels at the same speed provided a wheel 2¼ inches in diameter were used instead of the 36-inch wheel. The ignorance of mechanical lore displayed in this statement is so apparent that we gaze upon it in bewildered astonishment, and wonder how it could have been penned by any writer of to-day, whether of high or low degree.

It is true that but few writers would now make such an awkward blunder as that. That assertion, in connection with many others less transparent, but equally erroneous, makes it certain that this heresy is still fondly cherished by very many that have so far been totally unable to entirely forget the traditions of the past and rise to the level of a nineteenth century range of thought. The delusion arises from the oft repeated observation and perhaps experiment of performing work with a lever in the hands of an individual, that could not be performed by the direct application of muscular strength. Those, however, that base their calculations upon such performances or observations must not forget that in all such tests, time is totally ignored, while in all mechanical work time is a dominant factor that is not and cannot be ignored.

A single glance at a wheel of any description ought to convince the most thoughtless that there is no such factor as leverage in mechanics. A wheel is a simple lever with the fulcrum in the centre. Every man knows that if he takes a lever and places a fulcrum under the middle of it, making both arms the same length, that he can raise no more weight with it than he can by a direct application of his strength. It is balanced work equals strength and strength equals work as we may want to make the comparison. That is all there is to the "leverage" of a wheel, and all that can possibly be made of it.

"Oh," but says the leverage crank, "while it is true there is nothing gained in leverage by the use of a single wheel, much is gained by combining wheels, as in that way we can increase the length of the long arm of the lever at will, and decrease the length of the short arm in proportion. By so doing we obtain unlimited advantage by leverage." Yes, so perpetual motion idiots have always thought, and presumably always will think as they follow each other in the paths of darkness and destruction.

But to illustrate. Years ago, when the writer was an apprentice, the question of leverage in mechanics came up now and then. The question came up more frequently then than now, because we were less enlightened then for discussion. On one occasion we were engaged in the construction of a wooden overshot water wheel, around one of the rims of which we were putting an iron segment rim, with teeth to gear into a pinion for driving the machinery of the mill. I had been thinking the leverage question over in reference to that wheel, and finally evolved a problem with which I intended to overwhelm the boss. On the first proper occasion I put it at him something after this fashion: "Now, then, Mr. K., you say that there is no mechanical gains in leverage. I want to ask you if, instead of putting a segment rim on the outside of the rim water wheel, which is about 18 feet in diameter, we would put a master wheel on the water wheel shaft 9 feet in diameter, if we could not gain two to one by leverage and exert double the force on the pinion?" "That is very true," he replied, "but in so doing we would reduce the speed of the machine, say just one-half." That reply knocked me out. I had revolved the question, as I had thought, from every point of view, but strangely enough, had not thought of that phase of it. It was natural enough and plain enough when my attention was called to it, and I saw plainly that instead of cornering the boss he had cornered me.

"But to further illustrate," he said, "we will assume that this is a 40-horse power water wheel, and we are going to use it for raising a weight of 33,000 pounds 40 feet high per minute. The raising of 33,000 pounds one foot high per minute, you know, equals one-horse power, as we are now constructing the wheel and arranging the machinery. But, as said, if we substitute a 9-foot master wheel for the segment rim we reduce the speed of the machinery just one-half, and can therefore lift the weight but 20 feet high per minute instead of 40, as now intended. To raise 33,000 pounds 20 feet high per minute requires but 20-horse power, which is but half the working strength of the wheel. We can therefore raise the weight 66,000 pounds 20 feet high per minute, which just equals 33,000 pounds 40 feet high per minute. So you see there is nothing gained in actual work by your supposed gain in leverage. It is a stand off. Nothing ever has and nothing ever will be gained in that way."

I was convinced, and from that time until now have never been guilty of advocating "leverage" as a factor in facilitating mechanical work. It can't do it, as the above sample lesson plainly illustrates. Foolish, indeed, is the man that clings to the fatal delusion, more especially if he attempts to utilize it, as many have done in wild perpetual motion schemes.

CONTRIVANCE FOR STOPPING AN ENGINE.

AN ingenious contrivance for stopping an engine in a machine shop occupies not more than a cubic foot of space, and consists of an electro-magnet, a system of small levers and a cylindrical chamber at right angles to the steam supply pipe, this chamber containing two connected valves—one thick and the other thin. When the steam is shut off the thicker valve lies across the main supply pipe; but when the steam is on, the two valves lie in the cylinder on either side of the upper pipe; when in this position the valves fit loosely enough into the cylinder to allow a strong pressure of steam on all sides of them. The motive power of the mechanism is furnished by two small electro-magnet spools, through which a current is sent by pressing the button in any part of the shop, this attracting to the magnets a small bar of steel which is fastened at one end of an angular lever; at the end of the lever's other arm, which runs horizontally, and on its under side, is a small notch, into which, when the machine is ready for action, fits the end of a vertical lever, to which is fastened a valve lever, hanging by the perpendicular, and so arranged that when it falls the two levers separate. The action of the magnet raises the end of the horizontal arm of the angular lever and loosens the smaller vertical lever, so that the weight of the valve swings it down in a semicircle, thus hitting a cam and tripping a valve. This exhausts the steam outside of the smaller valve in the cylinder, and the steam beyond the other drives it across the supply pipe with great force, shutting off the steam from the engine within fifteen or twenty seconds.

THE INVENTION OF THE MATCH.

HISTORY does not give to any one man the credit of inventing the match. That useful article reached its present state of perfection by a long series of inventions of various degrees of merit, the most important of which resulted from the progress of chemical science. Starting from the tinder-box and fyrstan of the Saxons, the first attempt to improve on the old sulphur match was made in 1805 by Chancel, a French chemist, who tipped cedar splints with a paste of chlorate of potash and sugar. On dipping one of these matches into a little bottle containing asbestos wetted with sulphuric acid, and withdrawing it, it burst into flame. This contrivance was introduced into England after the battle of Waterloo, and was sold at a high price, under the name of Prometheans. Some time after a man named Heurtner opened a shop in London. It was named the Lighthouse, and he added the inscription to the mural literature of London

"To save your knuckles, time and trouble,
Use Huertner's Eupyrion."

An open box, containing fifty matches, and the sulphuric acid asbestos bottle were sold for a shilling. It had a large sale, and was known in the kitchen as the Hugh Perry. Heurtner brought out "vesuvians," consisting of a cartridge containing chlorate of potash and sugar and a glass bead full of sulphuric acid. On pressing the end with a pair of nippers, the bead was crushed and the paste burst into flame. This contrivance was afterward more fully and usefully employed for firing gunpowder in the railway fog-signal. The next was Walker. He was a druggist at Stockton-on-Tees, and in 1827 produced what is called "congreves," never making use of the word "Lucifer," which was not yet applied to matches. His splints of potash paste, in which gum was substituted for sugar, and there was added a small quantity of sulphide of antimony. The match was ignited by being drawn through a fold of sandpaper, with pressure; but it often happened that the tipped part was torn off without igniting, or, if ignited, it sometimes scattered balls of fire about. These matches were held to be so dangerous that they were prohibited by law in France and Germany. The first grand improvement in the manufacture took place in 1833, by the introduction of phosphorus into the paste, and this seems to have suggested the word "Lucifer," which the match has ever since retained. When phosphorus was first introduced to the match-makers, its price was $21 per pound, but the demand for it soon became so great that it had to be manufactured by the ton, and the price quickly fell to $1.25 per pound. Many inventors then entered the field, and matches were sent in shiploads to all parts of the world.

FLOUR MILLING IN BRAZIL.

THE London Miller says "A brighter day seems to have dawned for the Rio de Janeiro Flour Mills and Granaries Limited. The directors' report for the year ending August 31, 1893, shows a net profit of £10,065 2s. 9d., which, it appears, will suffice to pay a dividend of 7s. per share, and leave a balance of £1,315 2s. 9d. to carry forward to the new account. Such a result is the more satisfactory, seeing that the internal condition of Brazil has not been during the past twelve months exactly favorable to the operations of trade. It is not surprising to hear that since the date at which the accounts were made up, that is to say, the close of August last, 'the working of the mill has been greatly interfered with by the disturbed state of Rio de Janeiro,' but it is well to know that the mill and its belongings have hitherto taken no serious harm, and that the staff are reported safe and sound. Even war's alarms cannot extinguish man's craving for food."