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(Illustrated articles are marked with an asterisk.)

RATING STEAM ENGINES.

It scarcely needs any argument to convince an intelligent mind that all statements of fact are valuable only as they are definite. The present system of rating steam engines by horse-power is, however, as indefinite as can well be conceived. When a manufacturer rates an engine at eight horses' power or ten horses' power, he generally has in his mind some general average of pressure in the boiler, and some regular speed of piston, but as both these factors are variable, his rating may be below or above what the engine will do in practice. Care is generally taken to rate engines below their capacity.

The old term, nominal horse-power, is still adhered to, particularly in rating marine engines, and though this gives some idea of the dimensions of the parts of a steam engine, it gives no idea of its real power.

Of a surety this indefiniteness is a disgrace to so accurate a science as that of steam engineering, in which everything else is now reduced to the finest possible measurement; and there is not the slightest valid reason why it should exist a day longer. There need not, it seems to us, be any difficulty in agreeing upon some standard pressure and number of revolutions, or, what is the same thing, speed of piston per minute, at which the power should be computed. This would at once remove the uncertainty of which we complain, as the power for higher or lower speeds and pressures would then be easily determinable.

We suggest as a convenient standard of initial pressure in the cylinder sixty pounds, and one hundred as a standard number of revolutions per minute. Engines could be then rated as to the number of revolutions above standard they could be run, and this, with the pressure the boiler can safely carry, would enable the purchaser to at once calculate the maximum power available with an engine of a given rating.

There is also no necessity for adherence to the horse-power as a unit. The foot-pound is the adopted unit of work in all modern treatises on physics, and the expression of the power of engines in foot-pounds saves one division in the computation. We think it is time that "nominal horse-power" and "actual horse power" should become obsolete terms. For all scientific and practical purposes the foot-pound is by far the most convenient.

These standards of measurement being once generally adopted, purchasers would have something tangible to guide them. There need be no mistakes made, as is now often the case, such as purchasing an engine of too great capacity for the steam producing power of the boiler designed to supply it, or the buying of engines of insufficient capacity to do the work desired. On the contrary, accurate guarantees of power might be demanded and given.

POWER OF PRIME MOTORS.

Perhaps in no department of mechanical practice are blunders more frequent than in the calculation of the power of prime movers necessary to perform the work of driving machinery. In our experience we have met with many such mistakes, and although these mistakes are not made by expert engineers, and though the proper method of procedure on the part of inexpert persons in erecting mills is to employ experts to make the proper calculations, an unwise parsimony, or an ill-founded self-confidence, often leads such people to rely on themselves and the rule of thumb, in selecting engines and water wheels, only to find in the end, that a larger expense is necessary to rectify their mistakes, than would have been necessary to avoid them.

To determine the power necessary to drive a given number and variety of machines, it is first necessary to ascertain the power requisite to drive each to its maximum speed. Happily here we have a large amount of recorded experience to guide us with reference to those machines which have been much used; but it often happens that machinery of an entirely new pattern is to be driven, and then books of reference fail us, and resort must be had to experiment.

The dynamometer is the instrument relied upon for such experiments, and as there are several in market which answer the purpose sufficiently well, we shall not refer to any one in particular, but confine ourselves solely to a brief discussion of the principles upon which they, as a class, act to determine the two things they may be instrumental in determining; namely, the power transmitted by rigid or flexible connectors to different machines or sets of machines driven from a common shaft, and also the power required to drive any machine or set of machinery.

Let it be remembered that the dynamometer only can measure power transmitted. Hence it cannot directly determine the power of a prime motor. It may do so, however, indirectly, when such a motor is running at a regular speed, and transmitting its maximum of power through the dynamometer to shafting or other machinery, or exhausting this power in overcoming the friction of a brake. The latter is an instance of transmission of power and the conversion of work into heat.

The dynamometer, of whatever style or construction, only indicates static pressure, and the power transmitted through the instrument is estimated by multiplying this pressure in pounds by the number of feet through which it is overcome per minute. The product will be in the denomination of foot-pounds per minute, which is reduced to horse power in dividing by 33,000.

Mistakes are often made by those not accustomed to the use of dynamometers in confounding mere pressure with power. It is only a short time since we had quite a long argument with an intelligent mechanic who asserted that a dynamometer whose pointer indicated a heavy pressure on a slowly moving shaft, was driving more than one on a rapidly revolving shaft, the indication of which was much less. It was only by the application of the above rule, and a *resumé* of the subject of mechanical power that we succeeded in convincing him that the rapidly revolving shaft was transmitting the greater power, notwithstanding the lesser indication of the dynamometer. There seems to be a difficulty in the minds of some in making and maintaining a clear distinction between pressure and power, and many make this error in thought who never make it in actual practice, their calculations being made from prescribed rules and formulæ, which they use without mental analysis, and the full force of which they therefore fail to apprehend.

Brakes are merely instruments for taking off power from motors that it may be measured. The measurement is accomplished by a lever and a weight, on the principle of the steelyard. The brakes gripping the shaft or pulley, as the case may be, are tightened till their resistance is sufficient to absorb the power so that the motor shall run at the required speed. The weighted lever is used to hold the brakes, the weight suspended therefrom being of sufficient magnitude to keep the brakes from turning with the shaft. The weight in pounds multiplied into the leverage gives the number of pressure to which the shaft is submitted. This multiplied into the distance in feet through which the pressure is overcome per minute, is the number of foot-pounds the motor will raise per minute, which, divided by 33,000, is its horse-power.

The measurement of power rests upon these few and simple principles. It nevertheless requires skill and experience to apply them in such a way as to secure accuracy, and it is consequently advisable for those who lack skill or experience to employ competent engineers for such work.

We have been led to these remarks from frequent queries which cannot well be answered in our column devoted to correspondence of this kind. We trust we have now met these inquiries by as full a response as is possible without going into details, which would be a mere compilation from standard authorities on this subject.

THE PEOPLE WHO ATTEND FAIRS.

We know of no place where men—and women—do congregate in which one may study human nature to better advantage, or see more phases of many sided individuality than at mechanical fairs. To make such a study both profitable and amusing, however, one must have a broad sympathy for the feelings, and charity for the foibles of others, and a keen sense of the humorous, as well as power of philosophical analysis.

To enter one of these shows is to enter among a set of men who have, most of them, given birth to something which, in their opinion, is of great importance to mankind.

Some of them have good and sufficient grounds for this belief. Such a belief is the parent of an enthusiasm which shows itself, in the features of each exhibitor, in his gestures, in the adjustment of his dress, and in his speech. Enthusiasm born of conviction is a hard ghost to lay, and so, though cavilers may object to this, or throw cold water on that, the exhibitor, nothing daunted, rises superior to the occasion, and soars to the sublime hights of triumph at the first breath of praise.

See him as he stands waiting for the approach of some one who wishes to examine his device. Watch his eye kindle at the query, "How does it work?" With what expert haste he sets wheels and levers in motion and points out the action of each. Listen while he expatiates upon the advantages secured. See his lip curl in pitying contempt at the ignorance which seems to doubt that any detail may prove insufficient. Hear the outburst of eloquence with which weak objectors are utterly vanquished and driven ignominiously from the field. Surely if you please you may find something here which will reward your observation.

Then there is the man who objects to everything, whether good, bad, or indifferent, and who always looks on the bad side. He is the dread of the exhibitors. In the middle of their most successful harangues, when credulous minds are just on the verge of full belief, and old women have had their feelings wrought up to the "du tell" point, this objector elbows himself into the crowd, and with a word brings down the enthusiasm of orator and audience to zero. A hot discussion results. Out comes the exhibitor's pocket-book, and Mr. Objector is asked to name the extent to which he will back his statement, an invitation he rejects with much dignity. He is not a betting man. He objects to betting on principle, just as he objects to everything else, but he has spoiled the play, and the crowd disperses to other attractions.

Then there is the large family of meddlers always to be found in all places, but who always gather in force at fairs. They must smell every flower, touch all the fruit, turn at least once every winch belonging to churn or washing machine, pull every rope—in short, apply inquisitive—we are sorry to say sometimes acquisitive hands, to everything movable or immovable within the reach of their digits. The face of a marble statuette must feel their caressing and besmirching touch. Beauties in paintings are pointed out by the ends of their perspiring fingers. Nothing is sacred from their profane handling, and wherever they pass, irate looks and impatient words of annoyance follow them. Yet their faces are full of sweetness. They admire equally all things; and fancy they are doing their utmost to make all things as lovely and pleasant as possible.

Then, here and there, you shall note the aimless wanderer, always of the male gender, with melancholy eyes and pendant, overhanging eyebrows, thin, sallow, and dyspeptic, who, with hands in pockets, strides slowly up and down, looking at nothing, and almost unconscious of any external existence. What ever induced him to go to a fair? Give it up? So have we. It is a conundrum too deep for our solving.

And the sewing machine exhibitors. Ah! those men who send them here are shrewd old chaps, and know well enough that a sewing machine never looks so well as when a pretty and intelligent woman sits behind it, eloquent in looks, in nimble fingers, in tidy and tasteful dress, as well as in words. It is astonishing, indeed, how many young and even old men are interested in sewing machines. One finds out this singular fact at fairs, who else might forever remain ignorant of it. And the pretty exhibitors are certainly the instruments for the elucidation of this fact, for it is never apparent in the vicinity of a machine exhibited by a man. Being, therefore, instruments for the discovery of fact, they ought not to be excluded from notice in a review of a fair for a scientific journal. Far be it from us to exclude them. As an attractive feature of a well-conducted fair they are as important as brass bands or an opening speech from Mr. Greeley. We regard the men who employ them as public benefactors, deserving the gratitude and veneration of all who delight in fairs.

So we might go on, picking out and classifying character *ad libitum*, for whatever is lovely or hateful in human nature, conciliating or aggressive, high or low; whatever is opposite and extreme; whatever goes to make up the great current of humanity floating on towards the sea which will ultimately engulf all, you shall find it at one of these fairs if you seek it. Try it once, dear reader, after you have gone the rounds of the machinery and the various other displays, and find yourself with an hour to spare that you can fill in this way. Take our word for it, it will pay.

THE WORLD'S WORK, AND ITS MORAL NECESSITY.

"In the sweat of thy brow shalt thou eat thy bread," was a curse pronounced upon mankind for the original sin, if we are to accept the common orthodox interpretation of the mystic history of Adam's fall. We have, however, a modern saying no less true, but the sentiment of which somewhat conflicts with the popular idea that the sentence of work was designed to be a curse, the import of which is, that the devil employs the idle. The evil of idleness is, however, a trite subject which we do not mean to discuss.

The present age is emphatically the working age. In no other period recorded in the history of man, was there ever any approach to the amount of work now in progress. Not only is mankind throughout the civilized world exerting all its powers of mind and muscle in work, but the stored up brute forces of nature are harnessed to the chariot of progress, to an extent never before known. That there is a moral necessity for just the state of things which exists, is easily demonstrable.

The moral necessity for work is perhaps most strongly indi-