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## GAIN FROM THE APPLICATION OF CONDENSERS TO STEAM ENGINES.

In the early days of the steam engine, very low pressure was ordinarily employed for engines with condensers, while, on the contrary, what was considered a very high pressure was adopted for engines that exhausted into the atmosphere. Hence arose the terms high and low pressure engines, the former being engines with, and the latter without, condensers. At present, a high pressure of steam is ordinarily carried in both kinds of engines, so that the terms do not describe the two varieties as well as formerly. Many engineers prefer to class engines as condensing and non-condensing, rather than as high and low pressure; and we recommend this classification to our readers, as the more correct of the two. One who regards economy puts in a non-condensing engine, if he has plenty of water in the locality; and many old non-condensing engines are being fitted with condensers, under the more enlightened engineering practice of the present time. Many more steam users would doubtless make the change, if they realized the gain that would probably result; and though this cannot be predicted exactly, for any given case, it can generally be estimated with tolerable accuracy.

It may be fairly assumed that a non-condensing engine has, on an average, at least two pounds per square inch back pressure on the piston. Some have much more than this, and first class engines have less; but two pounds can be considered a fair example of ordinary practice. By the application of a condenser, it might be expected that there would be a negative pressure of ten pounds per square inch on the back of the piston, so that the piston pressure would be increased by twelve pounds. In this assumption, an allowance is made for the power required to work the air pump, and the engine is supposed to be at seventy-five horse power. For an engine smaller than this, it would be better to allow an increase in the positive pressure of not more than ten pounds per square inch. As the condenser, by decreasing the back pressure on the piston, adds just as much to the positive pressure, it is plain that a lower pressure of steam can be used, or what is better, the steam may be cut off at an earlier point of the stroke. The gain in either case can be approximately calculated. If the gain in positive pressure produced by the reduction in back pressure be multiplied by one hundred, and divided by the mean effective pressure on the piston, it will give the *per centage* of gain in pressure due to the condenser.

Thus, if the mean effective pressure on the piston is thirty pounds per square inch, the gain in pressure will be 100

times 12, or 1,200, divided by 30, which is 40 per cent. Now suppose that before the condenser was attached, the steam was cut off in the cylinder at half stroke; under the new conditions the required mean effective pressure can be obtained with a lower boiler pressure than before. Before the condenser was in use, it would be necessary to maintain a pressure in the boiler of about 58 pounds per square inch by gage, to give a mean effective pressure of 30 pounds on the piston; while with an increase of 12 pounds in the effective pressure, by the application of the condenser, a boiler pressure of about 39 pounds would suffice. As the weight of steam per cubic foot at 58 pounds pressure is 0.17481 pounds, and only 0.132 pounds at 39 pounds pressure, there would be a saving of about 24.5 per cent in the amount of steam required to run the engine. Instead of reducing the steam pressure after attaching a condenser to an engine, it would be better to maintain the same pressure in the boiler, and cut off the steam at an earlier part of the stroke. In the case under consideration, the increase in 12 pounds of the effective pressure would permit of closing the steam port a little before the completion of one third of the stroke; and supposing that the clearance space in the cylinder amounts to five per cent of the capacity of the cylinder, the quantities of steam required per stroke, before and after the use of the condenser, would be in the ratio of 550 to 363, so that there would be a saving of 34 per cent.

The example given represents a case in ordinary practice. By varying the data, of course a greater or less amount of saving would result; but with an engine in good condition, it is generally safe to estimate that a saving from 20 to 25 per cent of the amount of steam used, and, consequently, of the consumption of coal, will be realized by the application of a condenser. Indeed, it is not unusual for manufacturers to guarantee this amount of saving, in converting a non-condensing into a condensing engine. Those of our readers who think of having their engines changed in this manner can generally, by consulting a reliable engineer and giving him full details, obtain a pretty correct estimate of the advantage that will probably be derived. Matters of this kind are strictly professional, requiring so much experience and technical knowledge for their proper consideration, that nothing but general hints can be given in a popular article.

It occasionally happens that no saving, or one of very small amount, is effected by the use of a condenser. This almost invariably indicates that there are leaks about the engine, which are so much increased by the reduction of back pressure as to balance the increase in effective pressure due to this reduction. Of course, all calculations of probable gain are rendered useless by the introduction of this element. The question of leaks is purely a matter of fact, and is not subject to calculations until experimental data have been obtained. This should be remembered by users of steam power, and we repeat the statement, frequently given before, that it is true economy to have steam machinery examined sufficiently often to enable leaks and derangements to be discovered and remedied. This is especially important in cases where the vacuum in the condenser may magnify leaks that were trifling when the engine was non-condensing.

## IMPRATICABLE INVENTORS.

"It is one thing to construct a machine on paper, but a very different affair to make it go," remarked a friend to us recently, as he ruefully regarded a roll of elaborate drawings, which represented the fruitless labor of a year or so of his earlier life. "If friction and gravity were only out of the way, what a great inventor I should be!" and with this sententious observation, the plans were reconsigned to their dusty shelf.

It certainly does seem an extremely difficult matter to convince mankind in general that the same operation, when it is plainly impracticable by simple means, through its variance with some natural law, is just as impossible with the most elaborate combination of machinery. Moreover, as a corollary to the above proposition, and as a general rule, if we set about a piece of work wrongly and make errors (through negligence, through forgetfulness, or through ignorance) in its course, losing sight of the pitfalls in our road while regarding only the brightness of the goal, it is equally certain that the grand result we seek will not be reached. This neglect of detail, impracticability of design, in brief, appears to be one of the commonest difficulties in which inventors are prone to involve themselves; and the reason is that they become so completely imbued with the single grand idea that they fail to see anything of apparently minor importance, utterly oblivious of the fact that perfect parts alone constitute a perfect whole.

It is related that Brunel, the great English engineer, was constantly visited by inventors desirous of submitting their designs to his expert judgment. Although frequently wasting time of the utmost value, in the examination of impracticable schemes, he would patiently listen to the description, and then point out the fallacies in the chimerical projects. An enthusiastic individual came to him one day with a plan for sweeping chimneys; it would totally obviate the cruel employment of the small boys who were sent up the flues; it was simply a broom—a mere broom—which, worked from above, swept every minute crack perfectly.

"Excellent," gravely said Brunel, "but you have not told me how the rope is to be got to the top."

"Why, nothing is more simple," replied the sanguine inventor, "of course a boy will go up with it first."

At another time, the same celebrated engineer was interrupted in his labors by an Irish gentleman, who was burning to tell him all about a portable hood, which was to be

stowed away under an open carriage in fine weather, ready for immediate use in case of a storm.

"But you cannot stow away such an enormous thing as that in so small a space," objected Brunel.

"Certainly not," ejaculated the unabashed inventor, "it's not that that I mean to do. It's at home the thing is to be left when the weather is fine; of course it won't be wanted, then, you know."

It is this looking only at results, more especially when coupled with ignorance, not merely of principles but of what others have already proved useless, that has led many an inventor to despair, oft-times to ruin.

A simple incident in point came to our notice recently in the course of our weekly stroll through the American Institute Fair: Among the entries for exhibition was that of a rotary engine, which in due time was brought to the building by its constructor; and the inventor, with the aid of the proper officials, proceeded to set it up. The inventor—an old man whose dress and general appearance betokened a hard struggle with the world in days past—grew quite garrulous over his pet, and told how he had worked upon it for years, how he had spent every cent to get it built, and how he had now brought it from the far West to show the Eastern people what it could do. Then the blood would crimson his cheeks and his eyes glisten, while he would stop and gaze fondly on the insensate metal. When the placing of the machine was completed, the throttle was opened. Two turns were made, then another slow one, and then everything stopped. A second trial did no better. It was the first practical test, and the machine had never before existed except on paper. Then the inventor, with trembling fingers, moved a wheel here, a nut there; for some time he worked, but in the end he threw down his tools, and sinking despairingly into a seat, buried his face in his hands, and great tears stole slowly down his wrinkled cheeks. He saw that his treacherous fondling could never be made to run, and yet for three days he returned again and again to its side, wistfully gazing at it as if he hoped to gain some inspiration which would, after all, set everything right. But none came; none could come, for the very principle of the machine had long ago been exploded. Finally, heart-broken with disappointment, the old man started alone for his far-off home—not altogether penniless, however, for before he left his worthless engine was purchased from him at a good price by one upon whose labors in the same path fortune had abundantly smiled. Then others contributed their mites, and a sufficient sum was collected to enable the man to pay his passage home, without touching the little capital derived from the sale of his machine. That was a genuine and a noble charity, and, while the names of the generous givers are known to but few, the deed is one which an all-wise Providence will not allow to pass unrewarded.

## RAILROAD EMPLOYEES AND THEIR PAY.

It seems to us that the course taken by the managing powers of our public conveyances, relative to the payment of their employees, is far from the wisest that could be adopted. The plan appears to be not to encourage a feeling of common interest, or to impress upon the employee that so long as he studies the benefit of his employers his own will not be neglected, but rather to create a species of antagonism between the parties, in which any over reaching of one by the other is considered legitimate. Upon our city omnibus and car lines, it is perfectly well known that the pay of the employees is far below that to which their arduous labor would seem justly to entitle them. As a consequence, the positions are filled principally, not by a respectable and reliable class of men, but by persons either unfit for any business, or by those whose characters prevent their obtaining other employment, or by unfortunates whom reverses of fortune have driven to accept any means of support, however slender. It would be unreasonable to suppose that the majority of such individuals would or could refrain from speculation, and hence the "knocking down" system, as it is termed, has been carried on, year after year, until it has assumed such proportions that the street conveyance owners have at length become alarmed; and inventors of ingenious contrivances, which force stage drivers and conductors to be honest, are reaping a harvest. Natural honesty, then, is at a discount, and machine integrity rules the hour. As a mere matter of money, it would appear that it costs less to employ a scamp, plus a punch or a fare box, than to encourage upright service by the payment of a fair salary. The same policy is extended, on railroads and steamboats, to positions in which experience, judgment, forethought, and skill are all required. The traveling community, for its personal safety, is directly interested in the latter, and it seems to us a shortsighted policy on the part of the managers of our steam conveyances, whether carriers of passengers or freight, to pay only the lowest minimum of wages to their employees.

The average railroad car conductor is paid about as miserably, proportionately, as his brother of the street conveyance; and where the latter carries a bell punch to support his moral rectitude, the former is looked after by means of the duplex ticket system. And yet, with inexplicable inconsistency, a great corporation will commit to the fidelity of that individual, whom it tacitly admits it cannot trust with a few dollars, the care and management not only of valuable property, but the safety of human lives.

Not content with carrying out these peculiar notions as regards those on whom they depend for their money, several of the railroad companies are now manifesting a disposition to extend their demoralizing system, or a modification of it rather, into the ranks of the engineers. We do not mean