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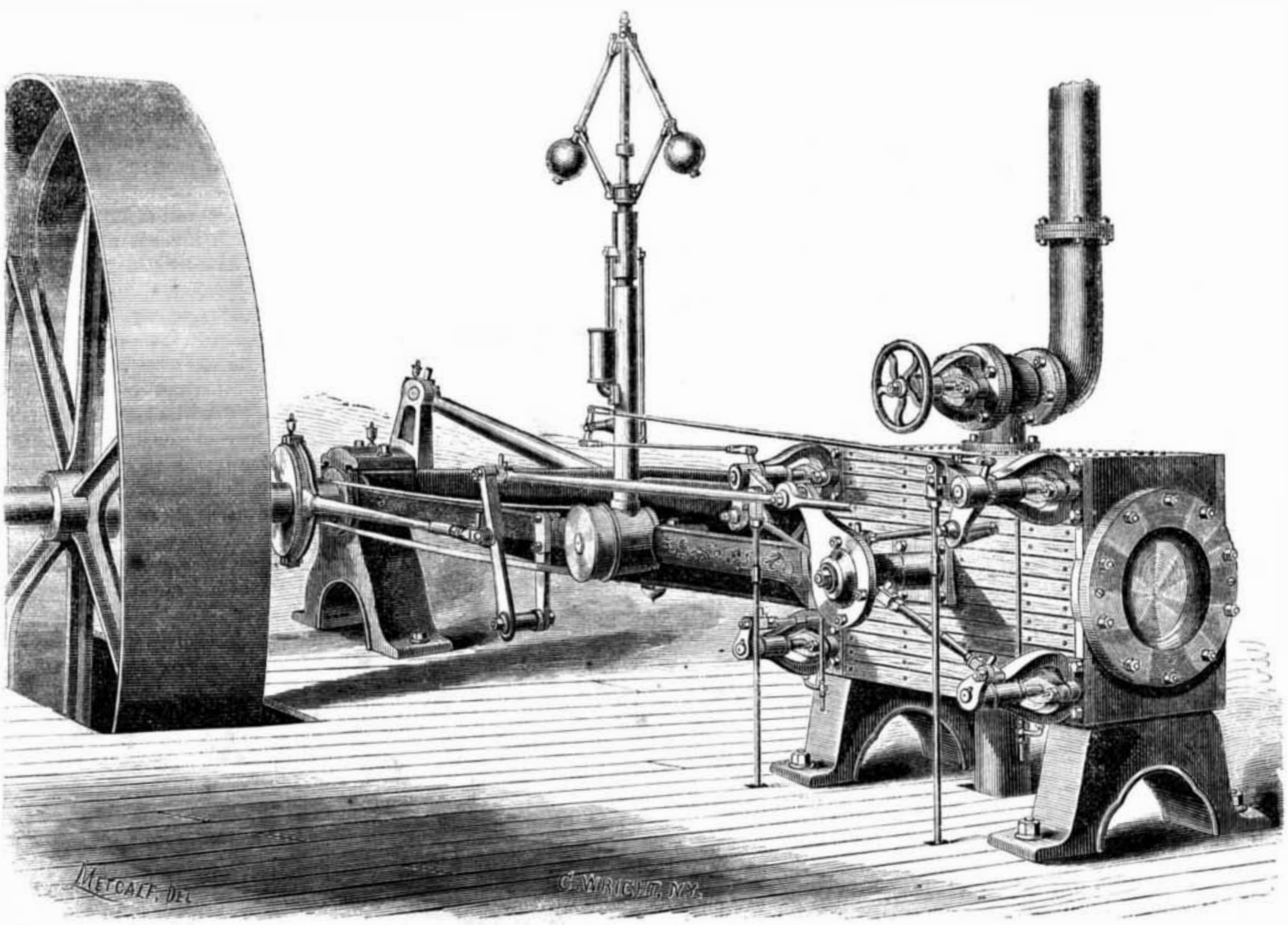
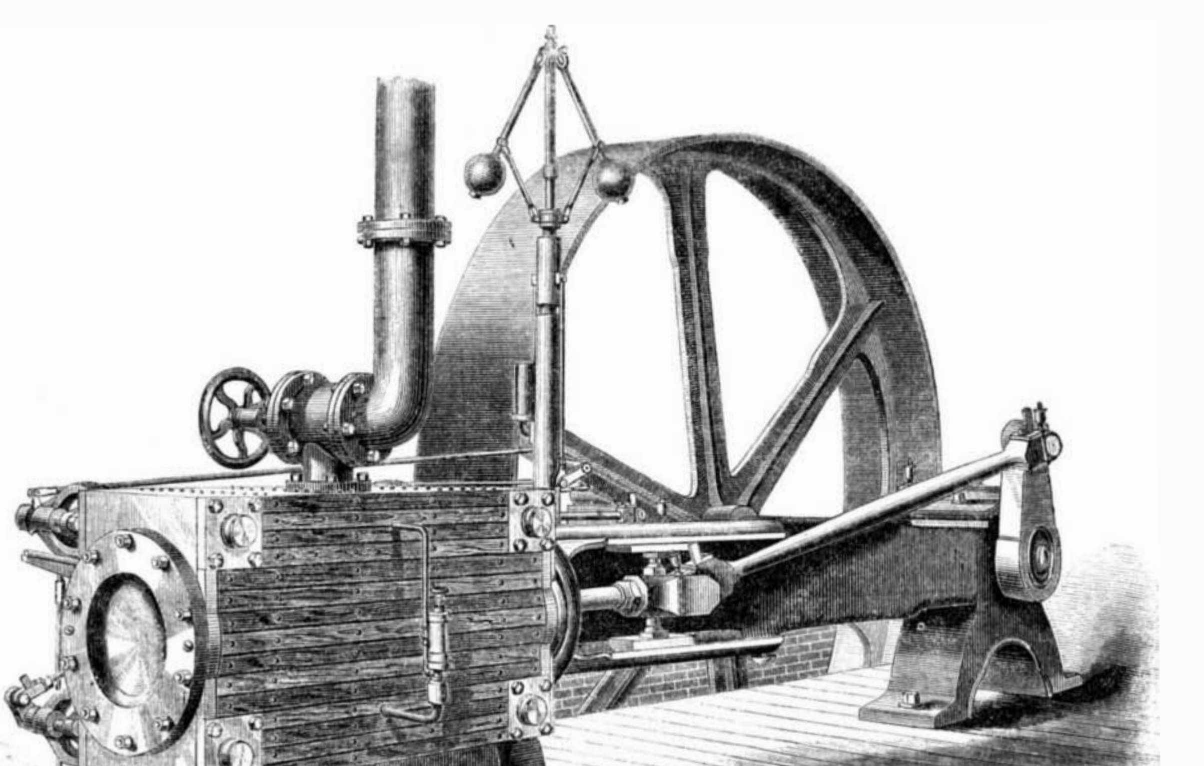




THE CORLISS STEAM ENGINE, BUILT BY W. A. HARRIS, PROVIDENCE, R. I.

The Corliss Steam Engine.

Probably no engine ever constructed has achieved a more enviable and widely extended reputation than the one we this week illustrate. It received the first competitive gold medal by unanimous vote of the International Jury at the Paris Exposition. It also took the first premium at the Fair of the American Institute, for 1869, and the inventor of the valve gear which constitutes the peculiar and distinguishing feature of the engine, and from whom the engine takes the name by which it is so widely and favorably known, has received a Rumford medal from the American Academy of Sciences in consideration of the merit of his invention.

The engine was exhibited for competition at the late Fair of the American Institute, and a test was made with the results of which our readers have been made acquainted through these columns. A statement of the results, based upon the amount of coal consumed, and the useful work performed—the only reliable basis upon which a computation can now be made—will be found in our advertising columns, and we call particular attention to this statement as furnishing a more minute account of the tests than any thing else yet published.

The peculiar merits claimed for this engine may be summed up as follows:

A most prominent and valuable feature is the accessibility of every part, which will be at once seen upon inspection of the engravings.

All parts of the mechanism which moves the valves are outside of the steam chest, visible to the eye, and therefore any derangement can be seen at once. One simple eccentric moves all the valves; no complication of gearing being used for that purpose.

The same valve admits and cuts off the supply of steam; no auxiliary valve riding on its back being necessary. This valve is placed on top in close proximity to the bore of the cylinder of the engine—say one inch—and opens directly into the clearance space; therefore there are no long passages to fill with live steam at each end of the cylinder.

The exhaust valve is situated *under* the cylinder, at the clearance space, and can therefore free the cylinder of water without the use of other devices, in the most thorough manner. This valve is also situated in close proximity to the bore of the cylinder of the engine, and therefore has no long passages there to fill with live steam.

The steam valve commences to open its port at one end of the cylinder when the eccentric is producing its most rapid movement, and as the motion of the eccentric is declining toward the end of the throw, an increasing speed is obtained by means of the wrist plate, which compensates for the slow motion of the eccentric. At the same time the steam valve, at the opposite end of the cylinder, commences to *lap* its port, by the motion of the eccentric, but by a reverse or subtraction of speed produced by the same wrist plate, which speed is constantly decreasing till the throw of the eccentric is completed. Or, in other words, the lapping and opening of the steam ports require, *each*, the same amount of throw of eccentric, producing, for instance, a lap of half an inch at one end of the cylinder, while the opposite end has an opening of one inch and one eighth. The exhaust valves are moved by the same eccentric and by the same wrist plate before spoken of, but they have a much greater travel, for the purpose of ridding the engine of the exhaust steam easily through the exhaust ports, which are as long and twice as wide as the steam ports, and therefore back pressure on the piston of the engine is avoided. The rapid opening and slow lapping of the exhaust ports are obtained, as in the case of the steam ports, but much faster, as the travel is greater on the opening of the exhaust than on the opening of the steam port, to get a full and free opening. The lap on the exhaust port of this engine is about three quarters of an inch; opening one inch and three quarters.

The constant variations of load upon this engine, are communicated to the steam valves instantly by the governor; the valves being moved by a force distinct from it yet subjected to its regulation. Thus, the regulation is not only adjusted according to every momentary change in the demands of the engine, but is also effected with absolute precision by agencies purely automatic.

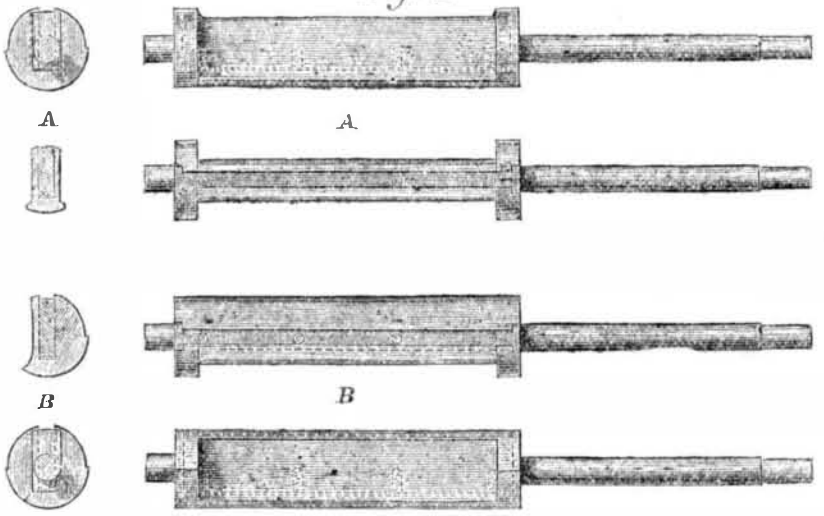
The governor in no case performs any labor; on the contrary, it only indicates the change required to the levers which move the valves. This does not task its powers. It puts forth only the force necessary to move a small *stop*. This movement is attended with the least possible friction, and the *stop* presents absolutely no resistance to the governor, except at the very instant when it is in actual contact with the lever constituting its fulcrum.

This momentary resistance, by the bearing of the lever on the stop as a fulcrum, occupies in an engine making sixty revolutions per minute, so small a space of time, that, compared with that during which the governor is left free to move the stop, it is practically nothing.

When the governor is combined with an auxiliary valve cut-off, as in some other engines, it is in fact converted into a connecting medium, and made not merely to indicate the point of adjustment but also to perform the labor of moving the valve to a certain degree; and it has to perform this duty after reaching through steam-tight packing or stuffing boxes. The packing in these stuffing boxes by use becomes hard, when new packing becomes necessary; or it leaks and it is necessary to screw up a little tighter; all of which must be done by hand, thereby putting the regulator under subjection or friction, variable, according to the judgment of the engineer. There is also the friction on the regulator in the auxiliary valve arrangement necessary to overcome the power required to move such valve through all its bearings, stuffing boxes, guides, etc., and under the pressure of steam. These distributing elements do not exist in the Corliss engine valve gear.

The governor is therefore extremely sensitive, as it is not saddled with two duties, *actuation* as well as regulation. A stop motion is provided for the purpose of preventing accidents should the regulator at any time, and from any cause, cease to perform its functions or become inoperative. This mechanism does not allow the steam valves to hook on, and therefore they cannot open. The result is that the engine is stopped by this mechanism *alone*, although the screw valve may be wide open.

Fig. 3.



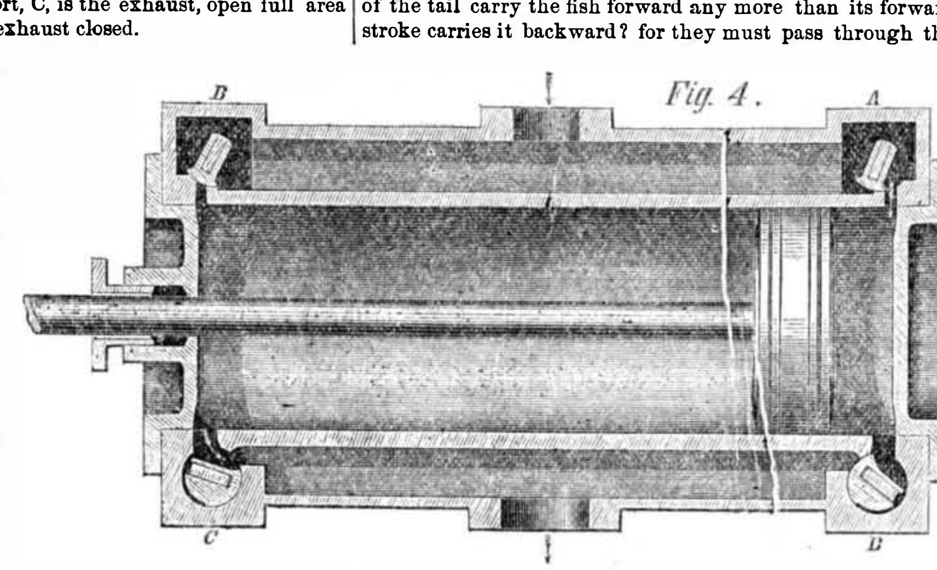
The valves are circular slides, motion being imparted to them by levers keyed to valve stems. These stems have a flat blade the length of the valve in the steam chest, and they oscillate on centers or fixed bearings in the front and back bonnets. The valves are fitted to these blades in a manner that admits of their adjusting themselves to their seats as the valve and seat from time to time become worn. The construction of the valve and stem is such that a valve can, it is claimed, be taken out in a shorter space of time than in any other engine, by taking out four bolts to remove the back bonnet, and drawing one key where keyed to the valve lever. Having four valves, either one can be adjusted independently of the other with great precision, and with the greatest of ease.

The valve gear can also be worked by hand with the greatest ease, and with 80 lbs. pressure of steam, can be run by hand, *backwards* or *forwards*, at the will of the engineer, which oftentimes is necessary in practical use.

The valves and blades, and their construction, are shown in Fig. 3, in longitudinal and cross section. Those represented by A show the steam valves, and B the exhaust valves.

Fig. 4 is a longitudinal section of the cylinder, steam chest, and exhaust passage, with cross sections of the valves. A shows one steam port open, and B the other steam port closed; the valves lapping the port, C, is the exhaust, open full area of port, and D the other exhaust closed.

Fig. 4.



It will be noticed also that the circumference of the exhaust valves, C and D, is partially cut away, thus reducing friction and allowing the acting portion of the valve to seat itself as it gradually wears. These devices are observed in the transverse sections of Fig. 3 as well as in the longitudinal section, Fig. 4. It will also be observed in the longitudinal section, Fig. 4, that the piston has traveled a very small part of the stroke, while the steam valve, A, and exhaust valve, C, have been opening the full area of their ports. The quick opening and closing of the steam and exhaust valves, and at the proper time (see Tredgold), with a positive mechanism for closing the same, has been a subject that has received the greatest amount of attention and thought from our most scientific engineers, and it is one of the principal subjects of the Corliss patent.

The workmanship of the engine is exquisite; that of the engine exhibited at the National Fair of the American Institute, which elicited commendation from every person competent to judge, was, as we are told by the builder, the same as that given to every engine before it leaves his works.

In style, as seen by the engravings, the engine must satisfy the most exacting taste.

Orders for machines, or requests for descriptive pamphlets, or for further information, should be addressed to W. A. Harris, corner of Park street and Promenade avenue, Providence, R. I., or at 49 Murray street, New York. [See advertisement on another page.]

How a Fish Swims.

Now, how does it swim? We have found that the successive or simultaneous removal of the dorsal, anal, pectoral, and ventral fins, only renders the fish's position unsteady; but he could swim as well as before. But if the end of the caudal fin be snipped off, its speed is diminished; if the entire fin is removed, it moves still slower, and with evident exertion, but bravely keeps it up until the tail itself has been cut off up to or beyond the anal fin; then at last the poor victim to science succumbs, rolls over and over like a log upon the water, gasps convulsively, makes a few desperate but ineffectual struggles with its abbreviated tail—and dies.

The sight appears more cruel than it is, for the successive cuts seem to disturb the fish very little; and as the whole is over much sooner than the dying struggles of a hooked fish, we may claim the right to make the sacrifice for our intellectual dinner—especially as it occurs by no means every Friday.

We have learned that a fish cannot swim without its tail. Let us now inquire how it swims with it. Very much as you scull a boat with an oar; but with the difference that in this case the oar is a part of the boat, and is flexible both in its length and in its hight.

Let us suppose our fish floating at rest in the water. Its tail is extended straight behind the body; suddenly it is bent to one side; this of course turns the head towards the same side, and perhaps carries the fish a little backward; but now comes a more forcible backward stroke of the tail, which turns the head the other way and propels the fish forward. Then, having reached the middle line, it is gently bent to the other side, and again forcibly extended. The result of these alternate movements of the tail in opposite directions is, as in the sculling of a boat, to propel the fish forward, not in a straight, but a zigzag direction. But the successive movements are so rapid that we notice only the resultant forward motion, which is in some species, as the salmon, at the rate of twenty or twenty-five miles an hour, and so powerful that the sword-fish has been known to thrust his sword through copper sheathing, a layer of felt, four inches of deal, and fourteen inches of oak.

But it may now be asked, "Why does the backward stroke of the tail carry the fish forward any more than its forward stroke carries it backward? for they must pass through the same space." There are four different reasons: First. The forward stroke is much less forcible and rapid than the backward. Second. The water is already moving; for the previous backward stroke of the tail from the other side to the middle line has forced the water in all directions out of its way, so that the further stroke forward meets comparatively little resistance; but the backward stroke meets all the more and is therefore the more effective in sending the fish forward. Third. This and the fourth reason depend upon the form of the tail, or upon the will of the fish.

There are some tails, such as those of the sharks and of the sea-snakes, which are long and narrow and stiff from edge to edge; and these are "feathered" like an oar. But the tail or an ordinary fish is not only much wider, but flexible in every direction, and capable of being spread out or narrowed by the action of little muscles attached to the bony rays which support it. Now such a tail may be feathered, and probably is, when the fish is moving slowly; but for more rapid movements it is probable that the whole tail is spread out and hollowed backward for the backward stroke; but that upon reaching the middle line it is narrowed and made convex for the forward stroke, so as to offer the least resistance to the water.

Those fishes which have scales overlapping each other are aided in still a fifth way; for in the forward stroke the scales upon that side of the tail would be flattened closely together so as to present a plane surface; but in the backward stroke the edges of the scales would be raised a little from the bending of the tail, and would offer a roughened surface to the water.—*From "Beast, Bird, and Fish," by Burt G. Wilder, in Harper's Magazine for December.*

PROFESSOR MORSE'S OFFICIAL REPORT UPON THE TELEGRAPHY OF THE FRENCH EXPOSITION.

COMPARATIVE SPEED OF INSTRUMENTS.

In the comparison of the speed of transmission by the different telegraphic systems now in use, the anxiety of Prof. Morse to properly set forth the merits of his own invention in this report has led him to some conclusions which we cannot but regard as inaccurate. He states, that in France and Prussia the Morse instrument is officially rated at twenty to thirty messages per hour, and the Hughes printer at fifty messages per hour, each message being calculated as equivalent to twenty words; but, in the table given of the results reached by American operators in special trials, the minimum rate is 1,600 words per hour, which is equivalent to eighty messages of twenty words each; therefore, Prof. Morse claims that the speed of his own instrument has been greatly underrated in the official European reports, and that it is actually the most rapid system in use. It should be borne in mind, however, that the actual discrepancy between the skill of American and European operators, though very considerable, is much less than would, at first sight, appear from the above showing. The rate given in the official reports represents the average speed of good operators under favorable circumstances, while that of the American operators is the result of special trials of selected experts, which as might be expected, give a very high average. A much nearer approximation to the true rate is that given by taking the average of a week's regular work in the New York office. This was done about two years since, and the result, as far as "through wires," or principal circuits are concerned, was as follows:

The Morse instrument transmitted, in a day of ten hours, an average of 300 messages of twenty words each, or thirty messages per hour.

The combination (improved Hughes) printer transmitted, per day of ten hours, an average of 325 messages of 20 words each, together with 4,000 words of press news, the whole being equivalent to 52 messages per hour. If the American lines were kept in as good working condition as those of Europe, these averages would undoubtedly be much higher, as may be proved by comparing the maximum speed per hour which has actually been obtained and officially verified:

The Morse apparatus in England, 1,476 words.
" " " " America, 2,704 "

The combination instrument, in the hands of an expert operator, has transmitted 2,700 words per hour through a circuit of 240 miles, a distance fairly representing the average length of circuits in the country. The Morse apparatus, as constructed and used in America, cannot be made to record, with certainty, over $1,800 words per hour, and this we consider to be about the average rate attainable in continuous work by the best American operator, under favorable conditions of the wires, while the rate of the combination printer, under similar conditions, is 25 or 30 per cent higher. Singularly enough, Prof. Morse makes no allusion whatever to the latter instrument in his report, although it is, practically, the most rapid one in use at the present day.

NUMBER OF MORSE INSTRUMENTS IN USE.

A mass of valuable statistics is brought together in the latter part of the report, which want of space prevents us from quoting as fully as we could wish. From reports received from official sources, in reply to questions propounded by Prof. Morse, and addressed to the telegraphic administrations of foreign countries, it appears that the Morse instrument has almost entirely superseded every other one throughout the civilized world—as might be expected from its simplicity, economy, and effectiveness. The Hughes printer is considerably employed in Europe on important through lines, as the combination is in America, and for this class of work it possesses incontestable advantages. From the returns, it appears that about 200 of the Hughes instruments were in use in Europe in 1867, the majority of these being in France. A careful estimate, based mostly upon official reports, puts the whole number of Morse instruments, employed in Europe, Asia, Africa, and Australia, in 1867, at nearly 12,000. In America, the Western Union Company report that they employ 4,000, and the various other lines cannot have less than 2,000 in daily use, including the railway lines and those of competing companies, as well as a large number in Canada, making a grand total of about 18,000 instruments of this kind in use at the present time.

MORSE'S TELEGRAPHIC INVENTIONS.

Now that the long and bitter controversy, as to the credit which is really due to Prof. Morse for his various inventions and improvements, has almost entirely died away with the expiration of his patents and the consolidation of rival telegraphic interests, it may be well to impartially examine the claims of Prof. Morse, as set forth in this report, as well as in the little pamphlet published by himself in Paris, in 1867. The inventions or discoveries here claimed as his own, by Prof. Morse, may be briefly summed up as follows:

1. The recording or generic telegraph, operated either electro-magnetically or electro-chemically.

2. The telegraphic relay circuit, or the opening and closing of a secondary circuit by means of a primary circuit.

3. The dot and line alphabet.

4. The use of sounds as a medium of receiving telegraphic communications.