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Improved Hot-air Furnace.

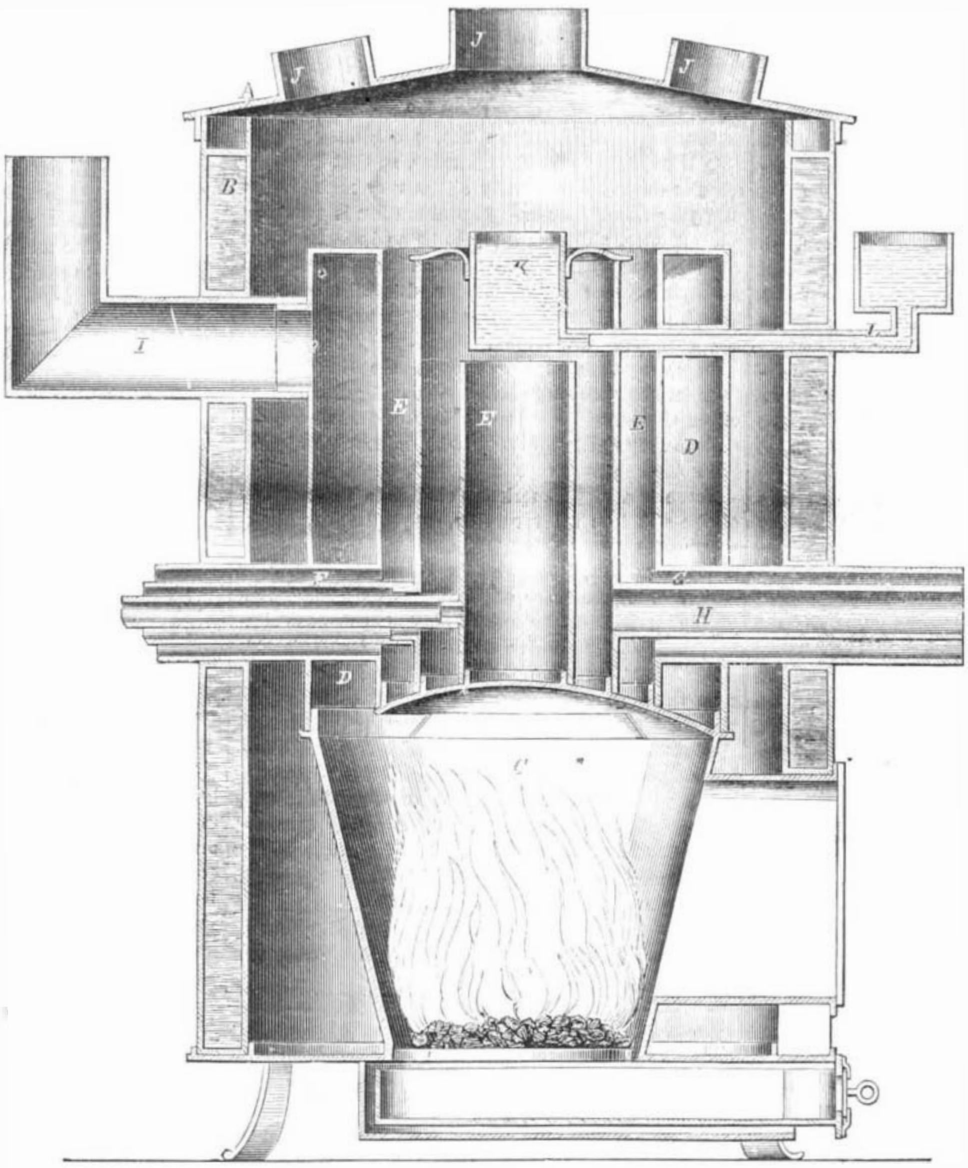
It is a well known fact to all who have given attention to economy in burning fuel that it is used to great disadvantage in ordinary stoves and ranges. In cooking stoves particularly the spaces are so cramped and the passages so contracted that the products of combustion, smoke and gas, completely choke them, so that all the draft that can be obtained is required to have an energetic fire.

A great deal of attention can be profitably bestowed on the common cooking stoves, for they are by no means economical, or so efficient, as they should be for the coal consumed.

The furnace here shown is intended for heating purposes. It is a moist hot-air furnace; so arranged that the air is charged with steam or moisture, as it passes into the apartments to be warmed, and deprived of the dryness which is so distressing to many and so apt to induce diseases of the throat.

In construction this furnace is simple. It is easily cleaned when foul, and requires no complicated array of dampers to render it effective. It is only necessary to build the fire and keep it burning, and the rest of the duty is done by the furnace itself.

In detail it is a structure, A, filled in with non-conducting material, B, so as to confine the heat in the center and prevent it from radiating. At the bottom of the furnace is the fire-pot, C, communicating with the combustion chamber, D, by segmental openings in its upper part. Above this fire-pot are the hot-air passages, E, surrounding one another and fitted with pipes, F G H, to convey cold air as fast as that already heated escapes.



DAYTON'S MOIST HOT-AIR FURNACE

The smoke-pipe is at I, and the hot air is distributed about the building from the openings, J.

A supply of water is maintained in the central vessel, K, through the tank and pipe, L. This being kept full continually insures the proper degree of moisture in the heated air. These are the principal parts.

This furnace seems to be very well designed for its purpose. The chamber wherein the products of combustion unite is large and roomy and is directly exposed to a high heat from the fire-pot crown. It is necessary that this should be so to insure ignition, or at least combustion of the smoke and gas. It should prove economical and efficient. A patent pending through the Scientific American Patent Agency. For further information address H. G. Dayton, Spencer House, Cincinnati, Ohio.

DEVIATION OF THE COMPASS IN IRON SHIPS

At a meeting of the Royal Institution of Great Britain on the 9th of February a paper, by Archibald Smith, Esq., M.A., F.R.S., was read, "On the Deviation of the Compass in Iron Ships."

The deviation of the compass is a subject of great and increasing importance, owing to the great and increasing amount of iron used in the construction of vessels, and the consequent increase in the amount of the deviation and in the apparent irregularity of its laws.

On the present occasion it will be necessary for me to omit altogether some of the most important and most interesting parts of the subject, viz., first, the mathematical part, including algebraical formulæ, arithmetical processes, and graphic constructions of great interest and utility; and secondly, the numerical results for different ships and classes of ships which have been obtained from the reduction and discussion of observations made in a large number of ships in the Royal Navy. I must confine myself to an attempt to explain the principles on which the forces which cause the deviation act, and the principles on which the deviations produced can be reduced to law, and to stating generally what has been accomplished, and what remains to be accomplished.

General Considerations.—1. A magnet is a bar of steel, the ends of which have opposite properties; they are generally marked N. and S. (north and south), but to avoid the confusion which would be occasioned by speaking of the magnetism of the north end of the needle or of the north end of the earth as south magnetism, it is convenient to distinguish them as red and blue (which may be remembered from R occurring in north and U occurring in south.)

The property is that the red end of one magnet attracts the blue end, and repels the red end of another magnet, and *vice versa*.

If we lay two magnets at a little distance in the same line with unlike poles turned to each other, and lay a soft iron rod in the interval between them, the soft iron rod will be magnetized by induction; the end next the blue pole of one magnet will become red, the end next the red end of the other magnet will become blue. If we turn the rod about its center, it will gradually lose its magnetism, till, when at right angles to the line of magnetization, it will be neutral, and if we turn it further, it will become magnetized in the opposite way.

The earth is a magnet, having a blue pole in latitude 70° N., long. 96° W., and a red pole in lat. 75° S., and long. 154° E. The direction of the magnetic force in London at present is the same as if there were a blue pole 20½° to the west of north, and 68° below the horizon, and a red pole 20½° to the east of south, and 68° above the horizon. This direction is called the line of force, or the line of "dip." If we hold a soft iron ro[illegible] the line of dip, it becomes instantly magnetized, the north or lower end becoming red, the south or upper end becoming blue. If we hold the rod vertically, the lower end will still be red, but of less intensity, the upper end blue, also of less intensity. If we hold the rod horizontally north and south, the north end will be red, but of still lower intensity. If we now turn the rod in the same horizontal plane, its magnetism will diminish till it becomes east and west, when it will be neutral, and if we turn it still further, the magnetism will be reversed; the amount of the changes will be greatly increased by hammering the rod in each position. In a rod which I used, the effect was increased by hammering from 12 to 80, or between six and seven-fold. If the iron had been perfectly soft it results from the experiments of Weber and Thalen that the effect would have been about 36.

A sphere of soft iron will be magnetized in the same way however held. The diameter in the line of dip will be the axis of magnetism, and the lower and north half of the surface will be red, the upper and south half blue.

In bodies of any other shape the effect will be similar, though less regular, if the shape be irregular.

In an iron ship, on the stocks, intense magnetism is developed by the process of hammering; red magnetism being developed in the part of the ship which is below and toward the north, and blue magnetism in the part which is above and toward the south.

As the usual position of the compass is near the stern, it follows that in the case of ships built head north, the compass is in a position where there is an intense blue magnetism drawing the north end of the compass strongly to the stern and downward, and generally producing a very large deviation, besides a large heeling error. In such ships it is of importance to have a standard compass well forward.

In ships built head south, there will generally be less deviation and little heeling error in the usual position of the compass.

In ships built east and west, the amount of deviation is generally small, but is less regular than in ships built head south.

Theoretical Representation of the Deviation.—If we place a magnet before the compass with its blue end turned to the compass, it will draw the north end of the needle to the ship's head, and as the ship turns round, there will be, in the first or eastern semicircle, a deviation of the north point of the compass to the right hand or east, in the second or western semicircle, a deviation to the left hand or west. This would produce one part of what is called the "semicircular" deviation.

The effect of the two magnets and the one iron rod, which we have considered, make up the whole of what is called the "semicircular" deviation.

If we place a soft iron rod vertically in front of the compass, with its upper end at the level of the compass, this end, which will be blue, will attract the north end of the needle, and produce a deviation of exactly the same kind as the magnet which we have considered. It will, therefore, simply increase the semicircular deviation caused by the first magnet. If the red end of the imaginary magnet, or the lower end of the imaginary rod, be nearest the compass, or if the magnet or rod be abaft the compass, an effect of the same kind, but in an opposite direction, will be produced.

A magnet to starboard or port of the compass will produce a similar effect, except that a deviation of one kind will be produced when the ship's head is on the north semicircle, and of the other kind when on the south semicircle. This is the other part of the "semicircular" deviation.

If we lay a horizontal soft iron rod in front of and directed to the compass, it will easily be seen that when the ship's head is N. S. E. or W. it produces no deviation. When N. E. and S. W. it produces a deviation to the right hand or E. and when S. E. or N. W. a deviation to the left hand or W.; it therefore produces what is called the "quadrantal" deviation.

A horizontal soft iron rod directed to the compass, but placed to the starboard or port, will produce an effect of exactly the opposite kind, and would correct that produced by the first rod; but if the second rod, instead of being on one side, passes, as it were, through the compass, it will produce exactly the same effect as the first rod. The two rods will then conspire to produce the quadrantal deviation.

A quadrantal deviation of the same kind will be produced if the first rod instead of being on one side of the compass passes through it, provided always that its force is less than that of the transverse rod.

The magnets and soft iron rods we have imagined must not be considered as mere possible cases, but as representing truly the actual case in all ships. They are, in fact, the physical interpretation of Poisson's general formulæ for the action of induced magnetism, which interpreted amount to this—that the effect of the iron of any body, however irregular, on a magnetic particle, is exactly the same as that of nine soft iron rods and three magnets. When the iron is symmetrically distributed, as in a ship, the rods are reduced five in number, viz., the four we have considered, and the fifth lying fore and aft, with one below the compass, which would make the heeling error greater or less with the ship's head north than it is with the ship's head south, but this is not an effect of much importance.

Effect in Particular Ships.—In wooden ships the semicircular deviation is represented by the effect of a single vertical rod of soft iron in front of the compass, and the quadrantal deviation is very small.

In iron ships the semicircular deviation is generally represented by the effect of a magnet at the part of the ship which was south in building, with its blue end turned to the compass.

Armor-plated ships are generally plated after launching; the semicircular magnetism is greatly affected by the position in which they are plated. If they are plated in the direction opposite to that in which they are built, the deviation is generally diminished; when they are built, the semicircular deviation is generally increased.

Change of Deviation from Time.—What we have called the permanent magnetism is in truth only sub-permanent, and changes much, particularly if the ship is exposed to blows or strains, so that the semicircular deviation generally alters very much in the first year after building. The alteration is generally a diminution, although it might be an increase if the compass had by accident or choice been placed in a position where the semicircular deviation from induced magnetism exactly counteracted that from the permanent magnetism.

In consequence of this change the Government has, on the recommendation of the Superintendent of the Compass Department, laid down a rule that no iron ship shall be taken up as a transport till it has made one long voyage.

There is a very remarkable change in the capacity of the soft iron for receiving magnetism by induction, which seems to indicate some molecular change in the iron, viz., that it becomes less susceptible of induction by the lapse of time. The effect of this on the strength of the iron is one of the most important points to which attention is now directed.

Change of Deviation from Change of Place.—When a ship sailing south reaches the magnetic equator, the earth's magnetism acts horizontally. The vertical soft iron rod which I have imagined will then have no magnetism, and the semicircular deviation arising therefrom will disappear. When she goes into south magnetic latitudes, the upper end will now become red, and will repel the north end of the needle, and change the direction of the semicircular magnetism caused by the rod.

There will be no corresponding change in the semicircular magnetism caused by the permanent magnetism, except that near the magnetic equator the directive force of the earth's magnetism being greater than in England, the amount of deviation which the same disturbing force produces will be proportionately diminished.

Careful observations on the changes which take place in the deviation of iron ships in different latitudes are much wanted. They are being made in some of Her Majesty's ships now in the South, but there are no means of procuring such observations from merchant ships.

No change is produced in the quadrantal deviation by a change of the ship's geographical position.

Effects of Special Arrangements of Iron.—The upper or lower ends of all vertical masses of iron produce powerful effects on the needle.

The stern post, iron stanchions, funnels, gun turrets, generally produce large deviations, but if the place of the compass is judiciously selected, they or some of them may be used as correctors.

Horizontal masses of iron, such as deck-beams, produce a great effect, generally increasing the quadrantal deviation and diminishing the directive force. Both causes of error may be reduced by having as little iron as possible immediately below the compass, or within a cone traced out by a line passing through the compass, and making an angle of 54° 45 with the vertical.

DESIDERATA.

I. *Royal Navy.*—The only desiderata seem to be that greater attention should be paid to the preparing a place for the standard compass, and to the position of the ship in building and plating. The position of the standard compass should be shown in the drawings of every ship, which, before being finally settled, should be submitted for the observations and suggestions of the Superintendent of the Compass Department.

Ships should be built as much as possible head south, and should be plated in the opposite direction to that of the building.

Careful recommendation as to the special points to be attended to have been submitted to the Admiralty by the present Superintendent of the Compass Department, and we may hope that much benefit will be derived from them.

A proof of what may be effected in this way, has already been given in the case of several of the ships of the Imperial Russian Navy, in which the arrangements made under the superintendence of Captain Belavenetz have greatly reduced the amount of deviation.

II. *Mercantile Marine.*—This is a more difficult question, from the want of any general superintendence, or any mode of establishing a uniform system, or any opportunity of receiving, recording, reducing, and discussing the observations made.

Till some change takes place in this respect, it is not probable that much improvement will be introduced, or that merchant ships will make their due contributions to the advancement of science.

What seems desirable is—

1. That in all iron steam passenger ships there should be a standard compass distinct from the steering compass, placed in a position selected from the small and uniform amount of the deviation at and around it.

2. That the deviations by the standard compass should be ascertained and returned to a department of the Government.

3. That these deviations should be carefully recorded, reduced, and discussed by a competent superintendent.

Many indirect advantages might be expected to flow from following, in these respects, the example of the Royal Navy.

THE ATLANTIC TELEGRAPH---MEETING OF THE NEW COMPANY.

The Anglo-American Telegraph Company has been established for the purpose of executing, in the course of the present year, the enterprise of laying a submarine cable between Ireland and Newfoundland, so as to connect telegraphically the Old World and the New, and to raise the cable partially laid last year in order to complete a second line to America. An important meeting was held on the 14th of March, in the Common Hall, Hackin's hey, Liverpool, for the purpose of having the prospects of the undertaking fully explained. It was very numerously attended by some of the leading ship owners and merchants of the town, and by the representatives of the various telegraph companies.

STATEMENT OF THE ELECTRICIAN.

Mr. Varley, electrician to the company, made a long statement, from which we extract the most interesting portions. He said that Prof. Wm. Thomson, professor of natural philosophy at the University of Glasgow, who was second to none in mathematical engineering, had gone very carefully into the question relating to the effect of the water upon the operation of laying and recovering cables. And from the fact that the strain on the cable was only fourteen hundred weight during the operation of paying out, he was enabled to calculate precisely what was the action of the water during the operation of submersion; and he had found that the cable from the ship, owing to its light specific gravity, and the resistance which it experienced in passing through the water, sank so slowly that the cable from the stern of the vessel to where it touched the ground followed an incline extending over a distance of no less than seventeen miles from the stern of the vessel; in other