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Contents:

(Illustrated articles are marked with an asterisk.)

THE AVONDALE COLLIERY DISASTER.

On the 6th inst. the telegraph wires transmitted news throughout the land that appalled every heart; one hundred and ten men, the dispatch informs us, were buried in a mine at Avondale, Pa., the only source of egress from which was cut off by a merciless conflagration, and there was little, if any hope that a single man would be rescued.

The worst fears have been realized; the bodies of the miners have been found huddled together smothered, after making such futile efforts as lay in their power to isolate themselves from the poisonous gases which filled the mine.

The heart-rending details of this sad catastrophe have been given to the public through the daily press, and we will not dwell upon them. Liberal donations have been made for the relief of the bereaved families of the miners with a hearty promptness which speaks volumes for the philanthropy of the country.

It is due to the Delaware, Lackawana, and Western Railroad Company to say that its action since the occurrence of the accident has been all that ought to have been expected. We are sorry to say that we do not think the disaster need have occurred, and that it might have been prevented at a less expense than the company has incurred in its efforts to soften the blow to the afflicted survivors. Common-sense and humanity would seem to demand that men exposed to the perils of coal mining should not be forced to depend upon a single narrow avenue of escape, liable to be cut off at any moment by an accident of this kind.

It is evident that the method in which coal mining is conducted is behind the age. Gigantic enterprises in engineering are conducted to brilliant success in other departments, and yet year after year coal miners are forced to go down to suffocate beyond the reach of help, or to be suddenly struck down by some fatal explosion.

We are glad to see that the subject of averting these calamities is claiming the earnest attention of scientific investigators and engineers in England, and the heart-rending disaster at Avondale will not be an unmixed calamity if the lesson it teaches be generally heeded in this country. Our European exchanges inform us that Mr. H. Bessemer, the well-known improver of the manufacture of iron, has suggested a remedy which seems likely to avert explosions. Gas in incased burners having combustion supported by compressed air will give a very bright light for a long distance; and by these lamps being placed at intervals in the mine, the use of the "Davy" can be dispensed with. The gas is fed from the ground above the mine, and the great air pressure within the lamp will force out the products of combustion, so that the gases in the mine will not be able to enter and explode. In the talked-of tubular tunnel to connect England and France this idea might also be utilized. All that compressed air can do is as yet uncertain; for if it be without and within a man simultaneously, life is supportable, and the brightest light beneath the waters in diving explorations or the laying of submarine foundations is ever desirable.

One thing should however be insisted upon, that a single avenue of entrance and exit to a coal mine shall no longer be deemed sufficient, and the miners will be sustained by the public press in demanding that more ample means of escape be provided.

A method for preventing explosions in mines, ha ing their origin in blasting, will be found in another column, with an engraving illustrating the apparatus employed.

THE ADJUSTMENT OF HOT-AIR FURNACES.

We are in receipt of our annual crop of inquiries in regard to the proper adjustment of hot-air furnaces, which we will attempt to answer as briefly, yet comprehensively as possible.

The apparatus for heating buildings with hot air may be divided into seven parts; namely, the fire-box and flues in which combustion is performed; the chamber through which the air passes to be heated; the cold air pipes leading to this chamber; the hot air pipes leading from it to the registers; the registers which admit the air to or close it off from the apartments to be heated; the external registers or openings which admit the cold air; and, lastly, the registers by which the exhausted air is permitted to escape from the apartments to make way for the warmed fresh air which enters. We have here a complicated apparatus, each part of which is essential to the perfect working of the whole; and the wrong adjustment of any may defeat the end sought; namely, to heat and ventilate equally and perfectly all the apartments connected with the apparatus.

The fire box should be cast very thick and heavy, the better to guard against sudden fluctuations of temperature caused by neglect in firing, or an overcharge of coal. The grate should be sufficiently open to admit of a good draft, and the dampers should fit accurately. In many cases the damper communicating directly with the smoke-pipe intended to be opened only in kindling the fire, becomes warped by the heat, so that it can only be imperfectly closed, and much of the heated gases passes through it instead of the heating flues, and thus escapes without having the heat abstracted. The grate should be easily dumped without danger of falling down, as is the case with many ill-constructed furnaces, and the bottom dampers should fit as tightly as possible that the draft may be fully controlled. The outer side of the fire-box and flues should be whitewashed.

The chamber in which the air is heated should be of ample size in proportion to the capacity of the hot-air pipes which lead from it, and should *always* contain a vessel of water.

The cold-air pipe leading to the heating chamber is in most cases too small. We have often seen this pipe having a sectional area of only 72 square inches to supply a hot-air service, the aggregate sectional area of which was not less than 616 square inches; making all due allowance for expansion, the cold air pipe ought to be twice as large in proportion as this.

We have lately seen in an exchange a recommendation that the external openings of the cold-air pipes should be trumpet-mouthed. This was asserted to be a panacea against the effects of varying winds which often reverse currents of air and send the hot current out into the street instead of the parlor or library. We have tried this experiment and know that it will not do. The only thing that will do is a vaned hood, or cowl, which always presents its mouth to the current of wind, no matter from what quarter the wind is blowing.

The hot-air pipes leading from the furnace are apt to get clogged where the registers open in the floor, by servants sweeping all manner of rubbish into them, as dust, bits of rags, etc. This is not only an obstacle to the flow of air but renders the danger that your house may be burned somewhat imminent.

Where, as is often the case, the hot-air registers open out at right angles from the side of a vertical pipe, one over the other, the top room will get the better of the others, unless the supply of hot air be far more than the capacity of the upper register to discharge. The branch register pipes should not join the main pipe at right angles, but at an acute angle, the apex of which is at the junction of the two pipes. Even then it may be necessary to extend a chute or apron from the upper side of the lower end of the branch pipe into the main pipe, so as to partially intercept the ascending current.

Finally, the ventilators should be in the bottom of the room. In this case the hot air which enters the room pure rises to the top, while the foul and effete air settles to the bottom.

AERO-STEAM ENGINES.

Our readers are well informed in the history of the attempts which have been made to substitute air for steam as an expansive agent in engines. With the commencement of these efforts the name of Capt. Ericsson will ever stand as one of the earliest pioneer investigators, and, should the success which is now claimed for the combination of air and steam, applied to the same purpose, be fully realized, that share of the honor attending it will be due to him, justly claimed by those who help to point out the way by which others may mount to success.

To the mechanical engineer the paper bearing the above title, read before the British Association at Exeter, will be one of the most interesting of any of the able and valuable contributions to the transactions of that distinguished body. We can give only a brief review of this paper at this time, but we may perhaps refer to it again at a favorable opportunity.

The first part of the paper was devoted to a review of the data by which it has been satisfactorily established that not more than one tenth of the entire heat of coal is on the average utilized by steam engines.

The author, Mr. Richard Eaton, of Nottingham, England, then discusses the practical difficulties encountered in the effort to substitute heated air for steam, the principal of which is, as our readers are already aware, the effect of highly heated air upon such metals as may be economically employed in the construction of machines.

He then proceeds to give a brief history of the new Aero-steam motor, which avails itself of air expansion, using at the same time steam, which removes the difficulty above mentioned.

Mr. George Warsop, of Nottingham, as the son of an air gun maker there, was born with aerial ideas, and although his only education was received at a Sunday school, and he was sent to work at ten years of age, he turned that education to such good account that before he was twenty he had in leisure moments secretly constructed an air engine. Later in life it was his privilege, while a working mechanic in New York, during his engagement with Mr. Ericsson, to observe the weak points in the system of that highly gifted and persevering inventor, and after years of research to supply the deficiences by a marvelously simple system of mechanism which, as far as present experience goes, promises complete success by means which, happily for the cause of economy and progress, seem compatible alike with physical science and mechanical construction.

In the first attempts at practically carrying out the system, the arrangement adopted was an ordinary high pressure engine with vertical boiler as used where fuel is cheap. An air pump is added, which is put in operation by the action of the steam engine.

Thus, cold air is taken in by the air pump and is forced on in its compressed state through an air pipe, which, in the case before us is conducted first within the exhaust, then in a coiled form down the funnel of the boiler, then past the fire, and finally past a self-acting clack valve at the bottom of the boiler into the boiling water itself, rising naturally through the water, the air is intercepted and subdivided by diaphragms of metal gage. Thus a twofold service is rendered by the contact of the elements, the water becoming aerified and deprived of its cohesion and prompted to a free ebullition, while the air on rising above the water is saturated by the steam, and the two together pass on to their duty in the cylinder where saturation assists lubrication. The agitation of the water prevents scaling.

The machine thus constructed, but having two air pumps, and with cam motions applied to the valves as also to the poppet valves of the working cylinder, gave the following results, results which it must be admitted were sufficiently discouraging to have deterred the inventor and his associates from proceeding further in the matter, but for their faith in the intrinsic soundness of the system, and perseverance in carrying it to a practical issue. The work had to be done under disadvantages of various kinds, on inconvenient premises, which centuries back were a farm house standing within the ancient walls of Nottingham, and until the protection of the patent laws had been obtained, the original apparatus was carefully guarded in an unsuspected attic.

In this form of the apparatus the power obtained by the increased volume of the air forced in by the pump, did not compensate for that consumed in forcing it into the boiler. At the same time there were encouraging indications which led to further experiment. One of the air pumps being discarded, experiments were made with waste holes in the barrel of the other pump, to ascertain what proportion of air admitted to the boiler compensated for compression. It was found that about ten per cent of the effective consumption of fluid in the working cylinder gave much better results. At the same time the cam motions were discarded and the pumps left to their own unaided action. In this form it is claimed that a gain in work done by the combined air and steam engine was made of 42·5 per cent.

Here, although a very remarkable relative economy was apparent, it became obvious on consideration that danger of mistake would arise in assuming this economy as absolute, inasmuch as the duty performed, when contrasted with that obtained from engines of standard types, actuated by steam, was manifestly low, and it seemed probable that, as by judicious improvement in details, the duty was made to approximate more closely to fair steam engine duty, this relative economy might fall off considerably, inasmuch as there would be less margin to economize upon.

With a view of testing this point, and also for the satisfaction of railway engineers, of conducting experiments at locomotive pressures, a thorough remodeling of the whole apparatus was effected. The tappet motions were thrown aside in favor of the usual slide valve arrangement, working with a moderate amount of expansive action. The former wasteful vertical boiler was discarded in favor of a more economical one of the compound or Cornish multi-tubular description, so as to obtain a better evaporative duty from the coal consumed. The radiating surfaces of the cylinder pipes were re-clothed, and the feed water heated by the exhaust steam. Instead of exposing the air pipe to the direct heat of the furnace, as in the former case, the air became thoroughly heated on its passage from the pump to the boiler at a temperature of from 500° to 600° Fah., by being conducted through suitable coils and pipes through the exhaust steam in the heater, and the waste heat in the boiler flues and uptake.

When these changes were made a gain of 47 per cent over steam only, was claimed on an even pressure trial, and a gain of nearly 30 per cent on an open valve trial, a step in advance so huge that it staggers belief.

We shall watch future experiments in this field with the utmost interest in the hope that they may be successful, and that at last some decided progress in the conversion of heat into work has been made. Not that there has been no progress, but what has been made has been slow and painful, compelling, as it were, only a small fraction more of the heat which we know is constantly eluding us, to fall into line and do work. But 30, 40 per cent is something to make an engineer suspend his breath, aye, and his belief too, until the plain proof is before him that the results claimed are really