terminus. Above the deck of the tug are fixed a pair of rollers, between which this flexible iron band is placed, and as they are made to revolve by the steam engine on board, the grip which they take propels the boat. On the trial in question, after hauling various small craft of from 70 to 80 tons burden, she took in tow a Greek brig, laden with corn to the amount of 350 tons, which she towed against a head wind to the dock entrance, at a good walking pace. She hauled the common canal boats at a rate of 6 miles an hour, the speed being but little affected when going against tide. The cost of hauling in the Severn is a heavy item in the transit of goods, and this invention is calculated to diminish the expense 50 per cent., the consumption of coal being only 25 lbs. per hour.

Steam Engine Economy. By ROBERT DEMPSTER.*

As one great object of the *Practical Mechanic's Journal* is the recording of facts in science and art, may I solicit for myself a corner in its pages, for the purpose of making known some economical arrangements which I made upon a steam engine in the fall of 1847? The engine in question is a low pressure condensing beam, with slide valves of the ordinary D kind; diameter of cylinder, 26 inches; stroke, 5 feet. It has two steam chests—one at each end of the cylinder, connected by a pair of columns, one of which acts as the steam pipe, whilst the other contains the exhaust passage; the whole exterior having the appearance of a piece of architecture of the Tuscan order. The D valves are made and packed in the usual manner, and the state in which I found them was as under:—

Width of ports, ...	3½ inches.
Length of ports, ...	11½ “
Breadth of valve faces, ...	3¼ “
Cover on steam side, ...	¾ “
Exhaust being ¼ inch uncovered.	
Stroke of valves, ...	8¼ “

The alteration upon them I effected by the addition of a piece of brass to the steam side of each valve, with a change in the length of their connecting rod, and they are now in the following condition:—

Breadth of faces, ...	7 inches.
Cover on steam side, ...	2¾ “
Cover on exhaust, ...	¾ “
Lead, ...	⅛ “

The state of the valves at the extremity of their stroke is—

Bottom edge, opening on steam side, ...	1 3-16 inches.
“ “ “ exhaust, ...	3 3-16 “
Upper edge, opening on steam side, ...	1 5-16 “
“ “ “ exhaust, ...	3 5-16 “

The difference of opening on the opposite sides arises from the angles formed by the connexions. With this arrangement, the valve cuts off the steam at three inches past the half stroke of the piston, and the expansion continues from this point up to four inches from the termination of the stroke; and at this time the exhaust port is two inches open.

* From the Glasgow Practical Mechanic's Journal, for June, 1850.

On the return stroke the valve closes the exhaust. When the piston is 11 inches from the end of the stroke, at the bottom of the cylinder, the piston has a clearance of $1\frac{1}{8}$ inches, and at the top $1\frac{1}{2}$ inches. Supposing the semi-revolution of the crank to be divided into 180° , steam enters the cylinder during the performance of 94° , expands during 56° , and throughout the remaining 30° the steam is open from the cylinder to the condenser, so that the steam has allotted to it about one-third the time to rush out that it has to rush into the cylinder.

The annexed diagram was taken from the cylinder after the alteration, when in the regular course of duty. It is clear evidence of the correct action of the valves, and must be considered in connexion with the fact, that the expansion is entirely accomplished by the ordinary slide valve, with a face on the steam chest rather bad than otherwise.

The boiler pressure was 3 lbs., the diagram showing $2\frac{1}{2}$ lbs. with a vacuum of 13 lbs., the speed of the piston being 290 feet per minute. In the *Practical Mechanic and Engineer's Magazine*, vol. iv. 1845, you will remember I advocated the adoption of increased speeds in conjunction with high expansion, and I think the case before us is a tolerable exposition of the truth of my views. When the engine was first set to work, it was calculated for the old rate of 220 feet, but it has been shown that it might even run much faster than its present rate of 290 feet. Previous to the alterations I have described, complaints were made of the occurrence of shocks on turning the centres. Now, nothing of this sort ever takes place, although the valve faces are perfectly parallel on the edges, and open the ports directly across at once.

Some engineers are in the habit of putting *curved* lap-pieces on the steam side of the valves, in order to wiredraw the steam on its first entering the cylinder, so as to avoid the shock, or soften the action, of the entering steam upon the piston. Now the best examples of modern stationary engines get their steam instantaneously by means of conical, equilibrium, and many other kinds of valves; and I am led to believe, from my own actual experience, that the slide valve, with the usual straight outline, is already sufficiently defective as a wiredrawing valve, without making it still more so by these shifts. It has been stated that the curve has been introduced to avoid *flushing*—that is, an unsteady foot-lathe-like motion, experienced when expansion is carried too far. This objectionable action, which is

most injurious in spinning establishments, is, I suspect, rather to be traced to the sluggish movement of the piston—an allegation which, until very lately, few engineers would admit.

The fact of the closing of the eduction port when the piston is 11 inches from the end of its stroke, in the engine to which reference has been made, may perhaps be termed an unavoidable evil. Unavoidable it is, but how far the evil goes remains to be seen. The diagram shows that the pent-up steam does not reach the atmospheric pressure, there being the clearance and ports to fill. On the other hand, whatever shutting-up action does occur, would appear only to affect the smoothing of the reverse motion of the engine. In starting the engine, much difficulty is experienced in getting over the first centre, owing to the lap on the steam side, and the two-inch lead on the exhaust; but once over, if the vacuum is tolerable, there is no more trouble.

The Boiler.—The boiler is of the common wagon shape, 21 feet long, with an internal flue. The heat, after traversing the bottom, returns along the internal flue, splits in front, and passes back again along both sides of the boiler, finally entering by the damper into the chimney. The heating surface is made up as follows:—Bottom of boiler directly exposed to the action of the fire, 27·5 square feet; bottom behind the bridge, acted on by carried heat, 88 feet; central flue, 149·1 feet; side flues, 168 feet; front end, exposed to carried heat, 13 feet; back ditto, 5 feet; total, 450·6 feet. The length of the heat's travel is 63 feet; originally the furnace bars were 18 inches below the highest part of the boiler bottom, and the furnace projected so far forward that the first three feet of the boiler appeared to get the greatest radiating heat from the incandescent fuel. Retaining the original area of furnace, it was led back 22 inches farther under the boiler, lowering also the furnace bars to the depth of 12 inches, so that their level was made 2 feet 6 inches below the boiler. In this re-arrangement every part of the furnace is covered by the boiler, the frame of the furnace door being built in below the angle iron of the boiler end, so that the door, when closed, stands in a line with the boiler end. The present dimensions of the furnace now are—Length of bar surface, 5 feet; breadth, 4·3 feet; making an area of 21·5 square feet. Its mean height being 2 feet, its capacity is equal to 43 feet.

The space under the boiler, from the furnace backwards, was made of considerable capacity, and the bridge was built up in every part to 4 inches from the boiler bottom. The area of the throttling-place is about one-fourth that of the internal flue, so that the current passes this part at its highest rate of velocity. The use of this throttling action I may here shortly discuss.

The fire is kept as thin as possible, and generally, notwithstanding the attention of the fireman, a quantity of air must always pass through the grate, without a chance of combination with the incandescent fuel; and in addition, the heat continually sets free the volatile gases of the fuel. Much of the carbon also passes away as carbonic oxide. This waste goes on to its fullest extent when there is a tolerably thick bed of half-burnt fuel on the bars. Without the application of some remedial agent, each product would get away in its independent state, but the throat answers the pur-

pose of forcing together and mingling the gases, turning the whole mass to account.

The bridge is always at a great heat, and at periods when there is little smoke distilling, the action of the fire upon it raises its temperature to the maximum, and when a fresh charge of fuel is applied this heat is to a considerable extent liberated, and taken up by the smoke and passing vapor. The heat thus partly acquired from the bridge renders the vapor fitter for combination, and the object of the large space behind the bridge is to allow room, so that the current may pass away at a slower rate.

As respects the quantity of air to be admitted to the furnace, if the fire is kept very thin, the necessary quantity will always find its way through; but if at any time too little should be thought to be passing through, a remedy is easily provided in leaving a portion of the bars uncovered. With such an arrangement, coupled with moderate attention on the part of the fireman, it is possible to prevent the escape of visible smoke; but the avoidance of all smoke does not, in this plan, act so economically as when a little smoke escapes at charging or stirring the fire. 1

I had no means of accurately measuring the quantity of water evaporated by a given quantity of fuel, so as to give the economical value of the boiler; and no one is justified in condemning any form or setting of the boiler before its evaporative powers are ascertained. I cannot help condemning the practice of estimating the qualities of engines by the pounds of coal consumed per horse-power per hour. The question should be—how many cubic feet of water, at a given temperature, does one ton of a certain fuel evaporate from the boiler, and in what time? And for the engine—how many pounds are raised one foot high by each cubic foot of water evaporated? at what initial pressure does the steam enter the cylinder? and at what point is it cut off?

Some method of this kind will keep separate the merits or demerits of the engine and boiler, and a fair estimate may be made of the qualities of each. In the example I have given, the modifications on each were effected at the same period; and the result is, that 26 cwt. of fuel now goes as far as 39 cwt. did before.

To effect the perfect combustion of the gases derived from coal, it appears to me that the following points should be attended to:—

- 1st, That abundance of air be admitted amongst the burning fuel.
- 2d, That the air be caused to enter the furnace to *some extent*, without passing through the incandescent fuel.
- 3d, That the air and gases be prevented from losing heat before the atoms of gas and oxygen from the air have had time to combine chemically.
- 4th, That, to obtain the last desideratum, the products of combustion should for some time be shielded from the cooling action of the boiler.
- 5th, That, to effect this, it appears to be necessary to form a large space behind the furnace bridge; in fact, a space of a sectional area equal to that of the boiler, the flame to enter this space near the bottom, and the said space to be enclosed with brickwork, to prevent radiation.
- 6th, That the boiler be made conical, like a sugar-loaf; the side next the ground to be set horizontally, or even to dip somewhat towards the small end; with such a contrivance the steam would not reach far back in

the boiler, and with the cold water introduced at its small end it would not instantaneously rob the warmer portion of the water of its heat.

The fire is supposed to be at the large end, as also the steam chamber. No return flue is required, as the boiler is presumed to be made long enough without it. This boiler would have the greatest heat of furnace where the hottest water is required, and as the products of combustion pass onwards to the small end of the boiler they diminish in heat, and in like manner the boiler will diminish in heat, until, at the small end of the boiler, the heat will be about the same as that of the injected water. Here, then, is a most simple arrangement for robbing the products of combustion of their last particle of heat. The taper of the boiler may run out as small as it is possible to make it, or keep it clean, and its length is indefinite.

Blairgowrie, May, 1850.

AMERICAN PATENTS.

List of American Patents which issued in July, 1850, with Exemplifications by CHARLES M. KELLER, late Chief Examiner of Patents in the U. S. Patent Office.

1. For an *Improved Method of Fitting the Bows of Vessels*; Benjamin Barstow, City of New York, July 2.

The patentee says,—“The nature of my invention consists in making the cutwater of greater thickness or breadth than the forward part of the stem, to leave a space by each side for the receiving of sheathing timber, to cover and protect the forward part of the outer planking, and which also admits of giving better lines for the passage of the bow through the water.”

Claim.—“What I claim as my invention, is making the rear edge of the cutwater to project on each side of the stem, to form a recess on each side, substantially as described, in combination with the sheathing pieces which fill up such recesses, and which cover and protect the ends of the plankings, and which also admit of giving better lines for the passage of the bow of the ship or other vessel through the water, substantially as described.”

2. For an *Improved Method of Distributing the Air over the Heating and Cooling Surfaces of Air Engines*; Ernst Buckup, City of New York, July 2.

The patentee says,—“The nature of my invention consists in some improvements in hot air engines, whereby a greater economy of working is obtained, and also greater durability and efficiency are insured to the apparatus.

“My improvement consists in applying the inner plates to the hot air cylinders, to insure a more equal distribution of the heat, and also, by causing a current to pass over the heating and cooling surfaces, the liability to injury is greatly lessened.”

Claim.—“What I claim as my invention, is causing the air, entering or leaving the cylinder, to pass over the heating and cooling surfaces in a thin stratum, by means of the plates or their equivalents, substantially in the manner and for the purpose set forth.”

3. For an *Improved Sash Stopper*; Charles C. Cameron, Harper’s Ferry, Jefferson county, Virginia, July 2.

Claim.—“What I claim as my invention, is the triangular-shaped double acting wedges or fasteners, placed within recesses of corresponding shape formed in the front or rear sides of the sash side bars, or in the side slats of a window frame, acted upon by any kind of handles or levers, in such a manner that they will press the sashes inwards or outwards, (in contradistinction to sideways,) and thus retain them in any desired position, and render them airtight within the window frame.”

4. For an *Improvement in Straw Cutters*; Reuben Daniels, Woodstock, Windsor county, Vermont, July 2.

Claim.—“What I claim as my invention, is the method of feeding straw, fodder, and