

red-hot, and thus create danger. The source of danger and death is to be found in the direction to which I have alluded; and if there is one thing at all that creates astonishment in my mind, it is the fact that I stand here in this city of Manchester and state that it is unsafe to work a boiler under pressure which has not safety-valve fitted to it.

With the best intentions many boilers have taps fitted in the up and down pipes, as shown on the model and drawing Fig. 1, so that if any accident occur to the boiler it may be repaired or removed without fear of inundation. These taps have caused many fatal accidents in summer as well as in winter. If these taps are by any means closed when the boiler is at work, the water is sealed in the boiler, and nothing can prevent pressure accumulating unless the fire be put out. Only a few days ago I talked the matter over with an architect of no mean reputation in this district, who informed me that he would not think of permitting a good house to be fitted with a boiler which had not these taps fixed. He had ordered several houses to be fitted with taps under the copper cylinders, as represented on Fig. 2, A. A. I am glad to say he altered his opinion when I explained to him the facility which he thus gave to ignorant or careless people for creating a magazine of destruction. A destructive explosion was created in the house of Mr. Pease, of Darlington, by their means some short time since; and on the 9th October last, at a newly-erected West End club in London, a serious explosion was caused by them. To quote Mr. Lavington E. Fletcher, chief engineer of the Manchester Steam Users' Association, who has kindly rendered me valuable assistance in giving me some facts in connection with these subjects, the boiler was of the ordinary circulating class, connected to a cistern by two circulating pipes. Between the boiler and overhead cistern were two stop-taps; the hand hole in the boiler had been leaking, and a mechanic having been sent for to make matters right, on examining the boiler he shut off the taps. He then left the job, taking the precaution, however, to write over the fire-place—"This fire must not be lighted." Unfortunately, this warning was neglected. The fire was lighted at ten o'clock on the following morning; and as the outlets were both closed, the boiler burst about two hours afterwards, when the front was blown out, and the whole range shot forward into the kitchen. Fortunately, only one man was slightly injured, there being no one else in the kitchen at the time.

The fixing of these stop taps caused the death of a young woman in January of this year. This is known as the Eccles New-road accident. As it occurred in my own neighbourhood, and in Seedley Ward, which I have the honour to represent in the Town Council of Salford, I took more than an ordinary interest in it. I was the fore-man of the jury convened to inquire into the cause of death. It appeared that the proprietor of the house, actuated by a proper desire to make his house safe from inundation, consulted a plumber, who informed him that the best way was to fix two taps, one in the up pipe and one in the down pipe of the bath boiler. These were placed in the bath room, immediately under the cisterns, the boiler not having a copper cylinder. They were fixed where any mischief could have turned them at any time. A leakage during the thaw of entirely different pipes caused the proprietor to turn these taps off, and having done this he ordered the fire out. A plumber was sent for, and told to make all right; the leaking pipe was soldered, he reported all correct, but omitted to turn the taps on again. The result was that an explosion took place which removed the range of the house and the one next door, making a breach in the division wall sufficiently large for any one to walk through. The window was blown out, and the poor woman was blown half-way through it. No one was in the kitchen of the other house, or the consequences might have been more serious. The boiler, Fig. 3, which is on the table, measures 12 $\frac{1}{2}$ in. long, 16 in. broad, and is 10 $\frac{1}{2}$ in. high. The top and front were blown out in one piece; the area of this gives 240 in., which, if multiplied with the 250 lb. pressure required to burst a similar boiler, gives a total pressure of more than 25 tons. The new boiler, Fig. 4, on the table has been burst by me, by means of hydraulic pressure, by the little test pump attached to it.

I could give more details of similar accidents caused by these taps, but I think it scarcely requisite to occupy your time with them, having, I hope, proved how dangerous the practice is.

I will now proceed to those accidents caused through the stoppage of the circulation by the freezing of the water in the

up and down pipes. These accidents appear to occur chiefly when houses are entered upon by the tenants in the winter time, everything being cold, the water in the pipes being frozen. A fire is put under the boiler by the new tenant, and an explosion takes place. In very severe weather pipes have been known to accumulate ice in one night, those boilers fixed without copper cylinders being most dangerous. Not far from the scene of the Eccles New-road accident, about two years ago, a Mrs. Cowie was killed by an explosion from this cause. The water in the boiler had longer time than usual to cool on the Saturday night, and Mrs. Cowie having got up late on the Sunday morning, after the fire had been lighted a short time, the boiler burst, and she was blown across the kitchen and down the cellar steps and killed. Another accident from a similar cause occurred near Brunswick-street, Manchester, in January this year, which nearly killed a young woman, and I believe now she lies on a sick bed through the effects. At the same date the copper cylinder bottom (Fig. 6) which is on the table was blown out in a house in Pendleton; there was no one in the kitchen at the time, or they might have been scalded to death. There was another accident to copper cylinder at Gilda Brook, near Eccles; and in the same week the boiler that was fixed to replace the one that killed Mrs. Cowie burst with an accumulation of ice, the house being empty. One occurred at Glasgow on the 25th of December, which seriously injured a man; one at Burnley; one at Chorley, which killed a little girl, on the 23rd of December. In this case the tenant had only just entered, and a fire having been put under the boiler, it burst, with the sad result I have named. On December 28th an explosion of a circulating boiler took place at Foulwood Workhouse, near Preston, which killed one man and injured two others. December 30th one at Bradford, one at Delph December 8th, one at Ashton-on-Mersey on the 7th December, one at Bolton on the same day, and one at Hyde about the same time. There are a great many of these accidents unreported, because unattended with death. I have found that in the neighbourhood of Salford, where the woman was killed in January, that no less than five bursts took place about the same time.

Having endeavoured to show the two chief causes of these explosions, the natural question is what is the remedy? what will prevent this destruction of life and property? I have no hesitation in saying that if safety valves had been fixed that every one of the accidents would have been prevented. And as the ordinary lever safety valve would possibly become inoperative in course of time, a little pendulous safety valve of the Cowburn type, Fig. 7, has been recommended, as not likely to get out of order, by Mr. Fletcher, of the Steam Users' Association. If safety valves were fixed on the boiler, I think there is no great objection to the use of taps in the circulating pipes, as they are undoubtedly useful in case of accident. Weak plates of white metal, Fig. 8 D, have been recommended instead of safety valves, which would burst at a low pressure. I have made extensive experiments on these plates, and have burst a great number by actual steam pressure; but I found that I never could get two alike out of the same mixture of metal. There are also many other objections to them which I will not occupy your time with.

A word about copper cylinders for preventing explosions. Circulars have been issued by ironmongers in which it is distinctly stated that these things render an explosion impossible. This delusion, which has such a firm hold in the minds of many people, demands some attention. A copper cylinder fixed to a boiler makes it safer from those explosions which are caused by ice in the pipes. It is just possible that the death of Mrs. Cowie, which was caused by the water freezing in one night, would have been prevented by one, as the hot water in the cylinder makes it a storage of heat, which resist the attacks of cold for a longer time than a small pipe full will do when fixed as Fig. 1. A copper cylinder only delays the danger a few hours at most in severe winters, and its utility ends at that for preventing explosions. The bottom of the cylinder on the table for preventing explosions. The bottom of the cylinder on the table was blown out through one night's frost, and anyone having a cylinder who wishes to have an explosion in winter can have a hot bath late at night when the servants have gone to bed, he then can empty all the hot water out, which will be replaced with cold, and by this simple means reduce the power of its resistance to the effects of cold and thus cause great danger. A cotton broker