

A NEW TYPE OF DIRECT-FIRED AIR HEATER FOR TEA DRIERS

The orthodox air heater for supplying hot air to tea driers consists of nests of cast iron or steel tubes built on both sides of a fire box. The products of combustion are passed through or over the tubes while the air for drying the tea is drawn over or through these heated tubes. During the life of the stove considerable sums of money are spent on repairs to and renewals of these air tubes.

This type of heater has been in use for a great many years and while it has been satisfactory it cannot be considered as the most efficient machine for the purpose. The steelwork requires a fair amount of fuel to raise it to firing temperature and a lesser quantity to maintain it at that temperature. Usually the time taken to raise the temperature of the machine to that required for firing is one hour. During the process of raising and maintaining the temperature of the machine a certain amount of heat is lost by radiation.

If it is possible to reduce the time required to raise the temperature of the machine to firing temperature and to reduce the loss of heat due to radiation, there will be a saving in fuel consumption. Also if the air tubes can be dispensed with the maintenance costs will be reduced considerably.

Some years ago a new type of air heater was developed in Java in which there were no metal air tubes but the products of combustion were passed direct from the combustion chamber (fire box) into the tea drier. The fuel used was oil. A number of these machines have been in constant use in Java for several years with great success. It was found that due to perfect combustion obtained with oil the leaf was untainted even though the products of combustion were passed through the tea. At times there is an abundance of cheap firewood available in Java and on these occasions the direct-fired heater is not used because it is obviously unsatisfactory to use firewood in a direct-fired heater, because of the ash and possibility of fire due to hot embers being drawn through the machine.

The risk of setting fire to the factory when using an oil-fired direct-fired heater is negligible, in fact there is probably less risk than when a tubular stove which is fired with solid fuel is used. When firewood is used in an indirect heater it is possible for red hot embers to be carried up the chimney where they might be drawn up to the withering lofts. In the direct-fired heater all the fuel is burnt in the combustion chamber in front of the baffle wall and there are no hot embers to be drawn from the liquid fuel.

The brickwork of a direct-fired heater is always cool, which is an advantage in the drying room.

In 1936 the first direct-fired heater in Ceylon was installed at Ottery Estate, Dickoya, by Mr. R. C. Scott, with the approval of the Factory Fire Insurance Company and without any increase in the premium. This heater was designed by the Shell Company's Technical Department and differs from the Java heater in one or two respects. The Java heater broadly speaking consists of a wide metal tube bent at right angles, the metal tube being brick lined with four oil burners tangentially placed at the base. The heater installed at Ottery Estate is built entirely of firebrick and is fitted with only one low-air-pressure burner. Figure 1 shows a section and front view of this heater. Broadly speaking the Ottery direct-fired heater consists of an inner and outer firebrick chamber, the inner chamber which forms the combustion chamber extends about half the length of the outer chamber, the oil burner being fitted to the front of this combustion chamber. Perfect combustion of the oil takes place in the combustion chamber and air in sufficient quantities to dry the leaf is drawn through the ducts or passages formed between the walls of the inner and outer chambers. A thorough inter-mixing of the cold air and hot gases from the combustion chamber takes place at the back end of the outer brick chamber, the inter-mixing being assisted by a baffle wall of firebrick. The mixture of air and products of combustion at this point is now

at a temperature of about 200°F. and is passed directly from here through the machine in which the leaf is dried.

The direct-fired heater on Ottery Estate was built in May, 1936 to supply hot air to an old medium sized drier which had not been in use for some considerable time and was erected by the estate mason under the direction and supervision of a member of the Shell Company's Technical Staff. An ordinary brick bulking chamber was erected between the stove and the drier which acted as an additional mixing or bulking chamber for the air, and at the same time formed a convenient support for the chimney. A damper was fitted in the base of the chimney and another damper in the air duct leading to the drier, the two dampers being inter-connected so that when the chimney damper was open the drier damper would be shut. The object of this was to allow products of combustion to be passed up into the atmosphere when the burner was first lighted up. It was purely a precautionary measure to prevent the possibility of tea being contaminated by unburnt fuel. Ten minutes after lighting up the burner the stove was sufficiently hot to prevent any possibility of any fuel being imperfectly burnt and the machine was ready for firing the tea.

The accompanying illustrations show how simple is the construction of this type of air heater.

Figure 1 shows a section and front view of the direct-fired heater.

Figure 2 shows the estate mason laying the foundations and floor of the new stove.

Figure 3 shows the side and back walls nearly completed. The circular hole in the back wall is the duct through which the hot air passes into the drier.

Figures 4 and 5 show the finished stove. The cylinder on top is the burner atomising-air receiver and is so placed for lack of convenient space elsewhere. The low-air-pressure burner with automatic cut-off is clearly shown here. On the right of the burner a U-gauge can be seen which registers the pressure of the atomising air at the burner in inches water gauge. The chimney can be seen in the background.

Figure 6 shows the ordinary brick bulking chamber erected between the stove and the drier, and the hot air duct between the bulking chamber and the drier.

Figure 7 is a view taken from the front of the drier and clearly shows the drier, brick bulking chamber and chimney.

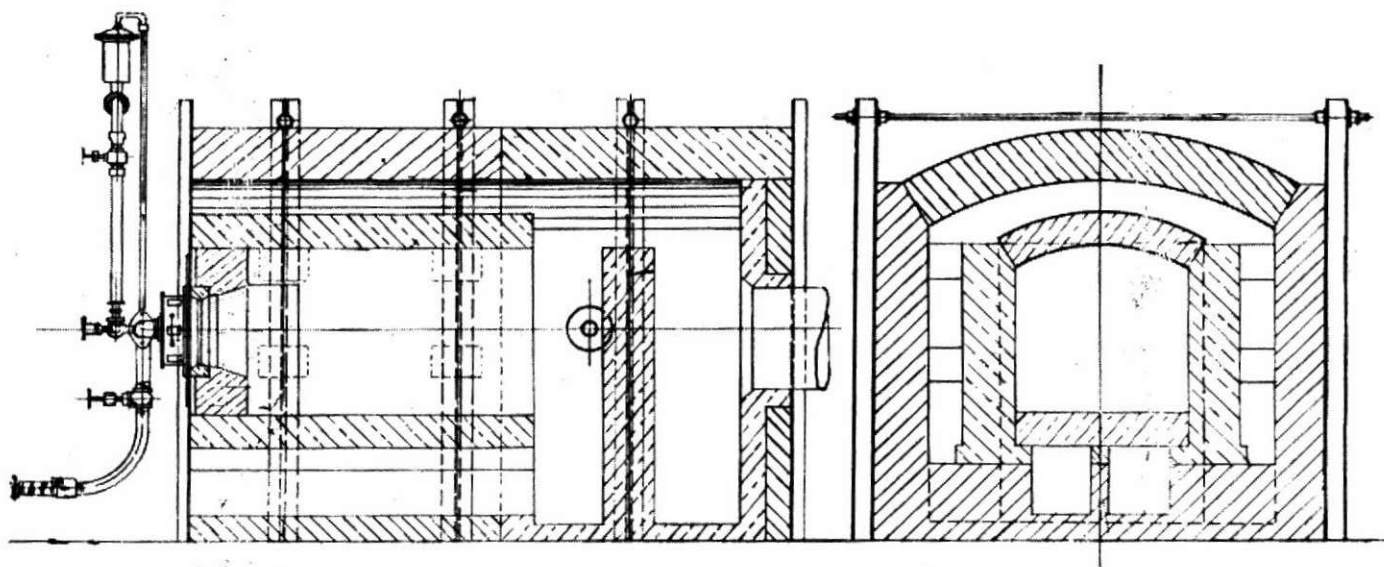


Fig. 1

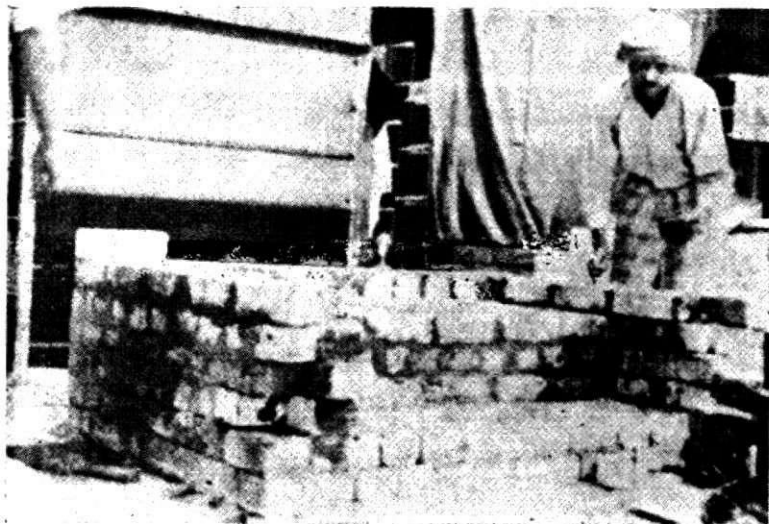


Fig. 2

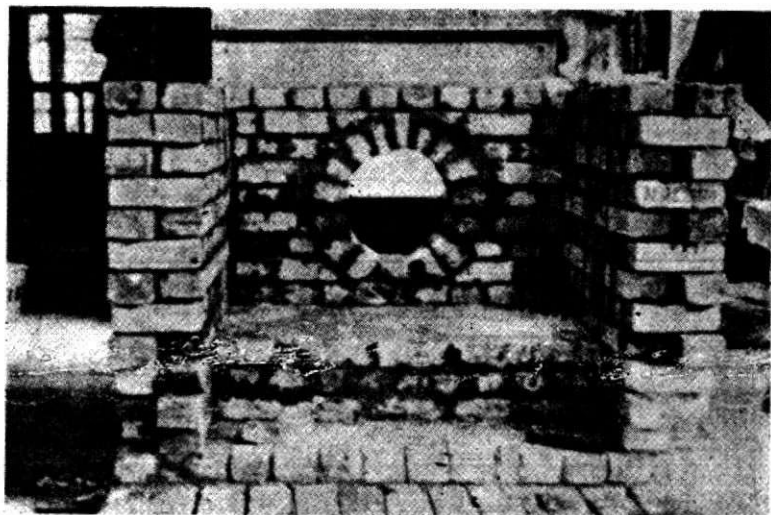


Fig. 3

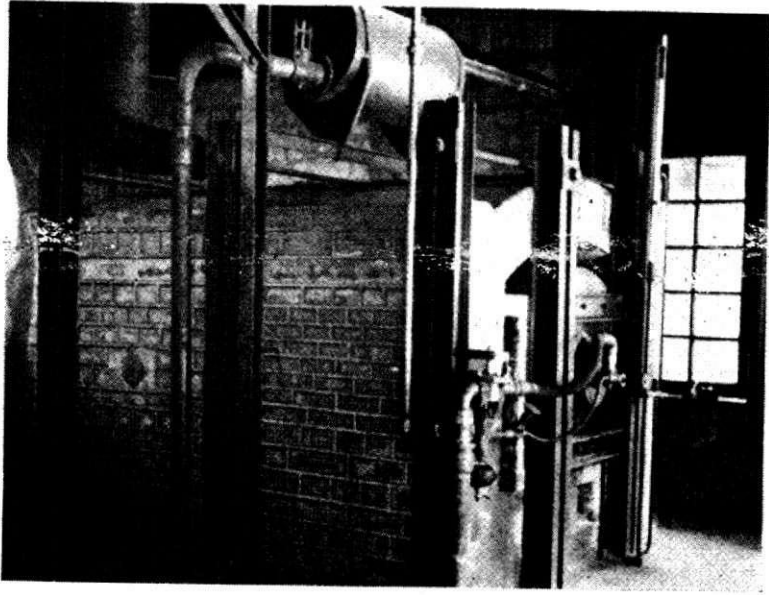


Fig. 4

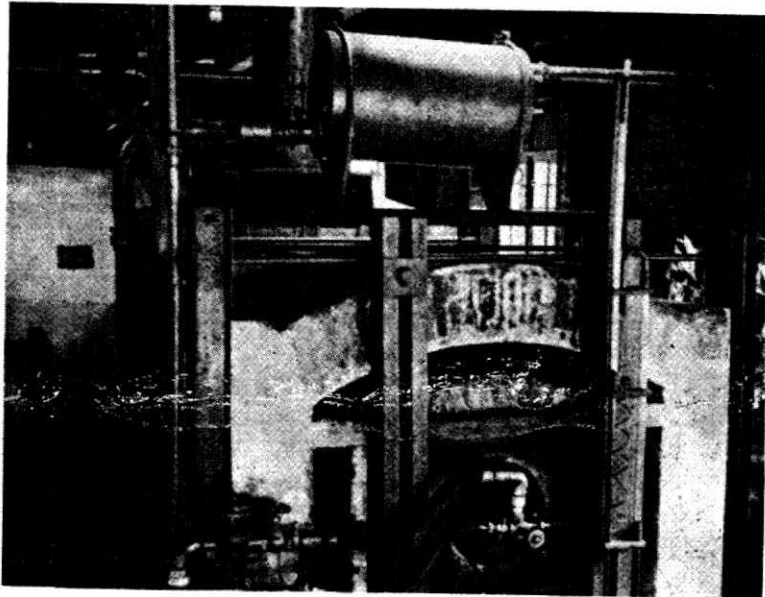


Fig. 5

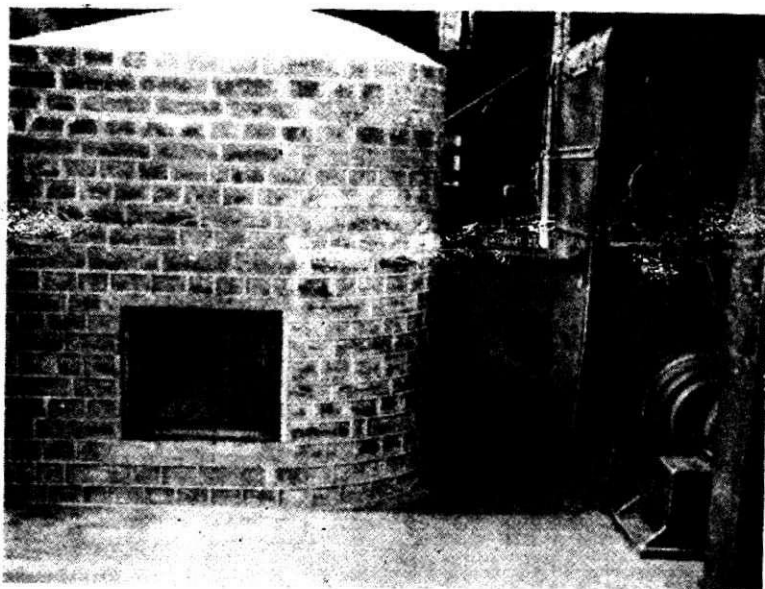


Fig. 6

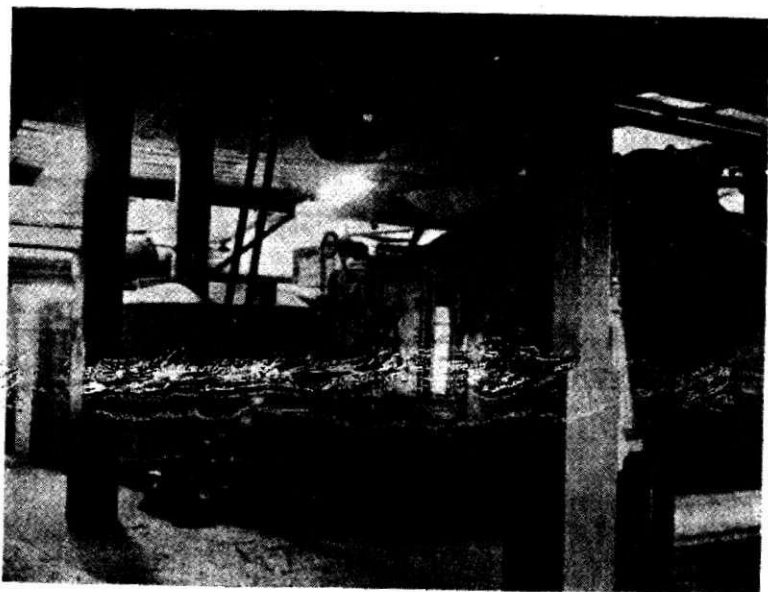


Fig. 7

A number of experiments were carried out with the heater and drier and later in the year the drier was put into commercial production with most satisfactory results as far as the heater was concerned. The drier was an old one and its performance was unsatisfactory, partly due to an abnormal amount of leaf "fall through" which necessitated leaf being withdrawn from the bottom and passed through the drier two or three times. This, of course, reduced the out-turn of the made tea per gallon of oil. The average out-turn of the drier under these conditions was 39.8 lbs. of made tea per gallon of fuel used and 39 lbs. of moisture evaporated per gallon.

The machine continued in full commercial production until early 1938 when Mr. Scott, the proprietor of the estate, decided to install a modern 4 feet drier with the area of the trays reduced to 3 feet in place of the medium sized drier.

The only alteration necessary to the direct-fired heater was to increase the area of the outlet for the gases.

In April, 1938 the machine was again placed in commercial production, and has been continuously in use since that date.

Between June, 1938 and April, 1940 the direct-fired heater has produced 536,737 lbs. of made tea with an average of 42.87 lbs. per gallon of oil used, the average quantity of moisture evaporated being estimated at 42 lbs. per gallon.

In analysing the figures it was interesting to note that, provided the drier is run at something approaching full capacity, the lbs. of tea obtained per gallon of oil is almost independent of the number of firing hours. With indirect types of air heater, which are fitted with metal air heating pipes, the amount of heat, and therefore fuel required to raise the stove, etc. to firing temperature, is such that, unless the drier is operated for several hours, the lbs. of made tea produced per lb. or gallon of fuel is very adversely affected.

During the twenty-three months during which records have been kept the first two months' out-turn of made tea per hour was 105 lbs. and 109 lbs. respectively and the lbs. of made tea per gallon was 30.4 lbs. and 35.37 lbs.

When the out-turn per hour was raised to 126 and 144 lbs., the lbs. of made tea per gallon rose to 44.8 and 51.28 respectively.

To sum up, the advantages of the direct-fired heater are :—

- (1). It is less costly to build than a tubular stove.
- (2). There are practically no maintenance charges — even for an iron chimney since mild heat passes up it for only 5-10 minutes after the burner is lighted.

- (3). It can be built for any size or type of drying chamber.
 - (4). It is very economical in fuel consumption.
 - (5). There is a great saving in time and fuel in raising the tea drier to firing temperature.
 - (6). The out-turn of made tea per gallon of oil used is almost independent of the number of hours the drier is in use.
 - (7). There are fewer radiation losses from this type of stove, thus making for a cooler firing room.
 - (8). Steady firing temperature can be maintained due to the quicker temperature response of the direct-fired heater to burner control.
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