

Small Cupola For The

by

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One man can easily handle this cupola. It will melt 35 lbs. of iron at a time, or about 300 lbs. per hour.

IRON can be melted in small quantities, and very inexpensively with the small cupola described in this article. The simple materials for its construction are obtainable almost anywhere. One man can easily take care of the furnace, charging the coke and metal, tapping and pouring. Under ordinary conditions it will melt about 330 pounds of metal per hour. This can be increased to 400 pounds per hour, but such rapid melting is hard on the lining and is not recommended.

The shell of the cupola consists of two standard 15 1/2-inch by 21 1/2-inch grease drums (Fig. 5). Cut the head and the bottom out of the one that is to be placed on top. They may be fastened together by small angle brackets bolted to the sides of the joint, which are then bolted together.

The grease drums are about 15 inches in internal diameter. The lining is made up with regular 3-inch cupola brick set in a mortar made of fireclay and water. This makes the internal diameter 9 inches. If the 3-inch cupola fire brick are not available, 18-inch diameter drums may be used and lined with ordinary fire brick set on end with the wide face on a radial line, making the internal diameter 10 inches. The space between the bricks should be filled with the fireclay mixture. The floor of the cupola is lined with a mixture of one-fourth fireclay and three-fourths crushed fire brick. Crush the fire

brick and sift it through a riddle to remove unbroken pieces. The floor lining should be about 3 inches thick at the back and sides and slope toward the tap hole where it is about 2 or 2 1/2 inches thick.

The two tuyeres (air-blast inlet ports), 3 inches by 1 3/4 inches wide are located on opposite sides of the shell 9 inches above the bottom of the drum, and 6 inches above the floor lining. Cut two 3-inch diameter holes in

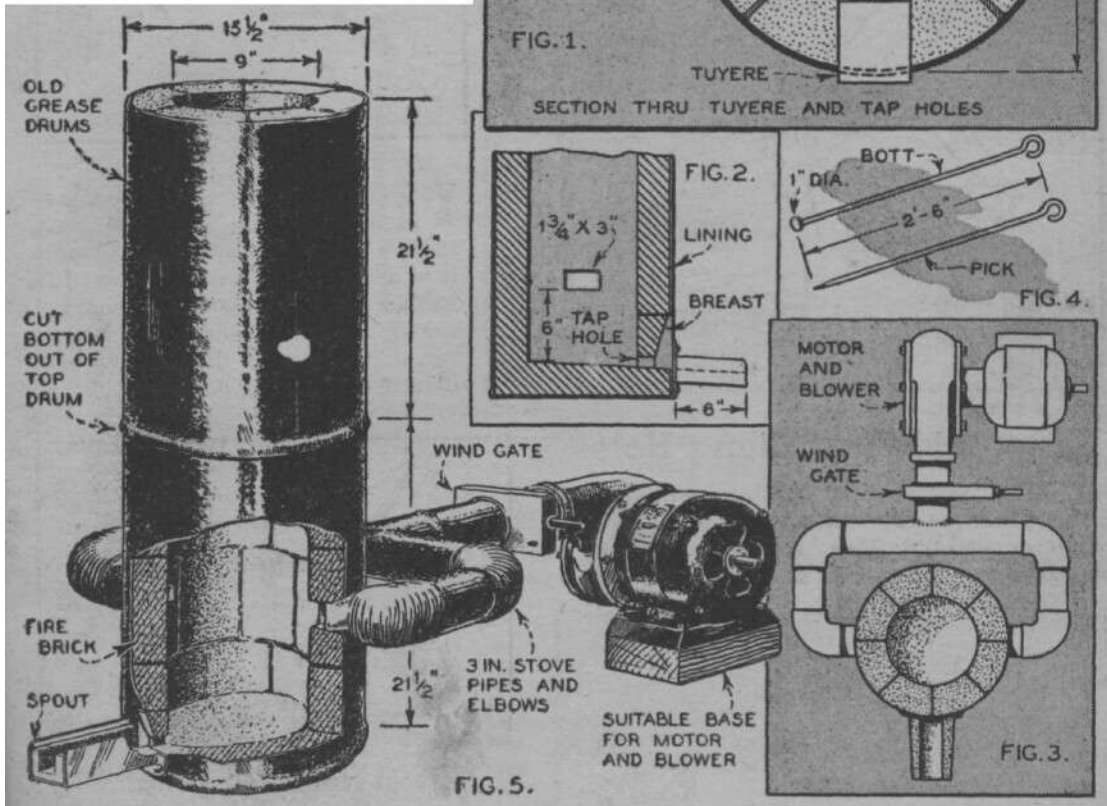
the shell and insert 4-inch lengths of 3-inch stove pipe, leaving one inch project outside. Shape the inner end as shown in Fig. 1. Then build the lining up around the tuyeres and fill in the space between the tuyeres and the bricks with the fireclay mixture. The breast opening is 4x4 inches. The spout is formed of heavy sheet metal, flanged on one end and bolted or riveted to the shell at the breast hole. These details are all shown in the sectional drawings, Fig. 1 and 2.

A blower capable of delivering 90 to 100 cubic feet of air per minute at 4 or 5 ounces pressure will be quite satisfactory. With this air blast pressure, the coke bed is carried from 16 to 18 inches above the tuyeres. You can check on this later by examining the lining which will show a fusion or "burning-back" a little above the tuyeres and extending upward to the top limit of the melting zone. When this has been determined, a measuring rod can be made to indicate the height to maintain the coke bed when charging the cupola. If greater pressure and air volume are used, the melting zone will be too high, causing an excess of sparks to fly from the top. Lower pressure will result in a lower melting zone and cold iron.

Fig. 3 shows the layout of the blower and the air-piping to the furnace. The 3-inch outlet of the blower leads through a windgate to a 3-inch T, and the air supply branches

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Scrap iron can be quickly and safely melted in small quantities for castings, etc. with this home blast furnace.



here, a line going to each tuyere. The piping is 3-inch stove pipe with the necessary ells. The windgate can be made up for you by a tinner. It is a simple sheet metal box with a movable slide to regulate the opening, and thus the air supply. Stove pipe makes an inexpensive and easily renewable air line. However, if a more permanent system is desired, 3-inch gas pipe may be used.

The cupola and blower can be set up on a frame built up of angle iron about 16 inches high. A movable wooden step can be built up to stand on while charging the furnace.

The fire is started in the cupola with shavings and small pieces of wood. Then add larger pieces of wood until the wood is piled

above the tuyeres. Then add a small quantity of soft coke. This coke is easier to ignite and will start the regular coke. Regular foundry coke should be used. To yield the 'best' melting service, the coke and iron must be broken up fine, the coke in chunks the size of an egg and the iron into small pieces with a maximum of not over 2 pounds when using good clean scrap.

Then charge in half of the amount of coke required for the coke bed. With the air admitted by the breast hole, sufficient heat should be produced by the wood fire to dry the lining and ignite the coke. If additional air is needed, you can temporarily disconnect

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the air pipes at the tuyeres. When the coke charged has become well ignited, add the remainder of the coke needed to bring the coke bed up to the required height. This can be measured from the top by means of the rod which was previously prepared for this purpose.

Don't let it burn too long, or you will burn the bed coke to a mushy state, and the weight of the later coke and iron charges will lower the coke bed. In about half an hour after kindling the fire, red spots will begin to appear on the top of the coke bed. Then prepare to close the breast and make up the tap hole.

Lay an iron bar ($\frac{3}{4}$ to 1 inch dia.) on the cupola bottom through the breast opening. Mix some fireclay to a putty like consistency and pack it in the breast hole against the coke and around the bar, closing the opening. When the bar is drawn out it will leave a tap hole as shown in the illustration Fig. 2. Line the spout with fireclay, joining it to the cupola bottom and the breast hole. Then turn on the blast for 2 or 3 minutes until the cupola is thoroughly heated before charging the iron. This will assure hot iron for small castings and give best results. The flame coming out of the tap hole will harden the clay in the breast and dry out the spout lining.

Coke and iron are charged into the cupola in the ratio of 8 to 10 pounds of iron to 1 pound of coke. For this small cupola, 40 pounds of iron will be about right. Select only the finer grades of iron scrap such as old automobile cylinders, machinery parts, unburnt stove-plate scrap, etc., broken up very small. The iron should be placed mostly toward the center. Then charge from 5 to 6 pounds of coke. The coke and iron should form distinct layers. There should be no bridging of iron from one layer of iron to the other through the coke. Charge as much iron and coke in alternate layers as required, or if for a long run, fill the cupola. In about 7 minutes molten iron will trickle down through the coke bed and will appear at the tap hole. It is then time to "bott-up" or close the tap hole. This is done with the bott-stick, Fig. 4. A lump of fire clay is placed on the end of the bott stick. It is then brought into the tap hole at an angle from above to avoid splashing of the hot metal.

The crucible, or that portion of the cupola between the bottom and the tuyeres will hold from 35 to 40 pounds of metal and fills every 6 or 7 minutes. It must then be drawn off so that it does not overflow at the tuyeres and into the windpipe. Experience will teach you how long it takes to fill your cupola crucible, and just when to tap it. The tap hole is opened with the pointed tool, Fig. 4, which is used as a pick to dig out the hardened clay.

The ladle should be ready at the spout, when the cupola is tapped. It would be well to pour the first tapping in a sand bed as the first run is

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usually "cold" iron, and unsuitable for small castings. Form little channels in the sand so that the iron will run into little "pigs" which can be easily broken and remelted.

In a small cupola like this one you will not be troubled with slag. However, if you wish you can throw in a few stones about the size of walnuts with the coke charges to flux the slag. Too much lime will cause a condition that attacks the lining of the cupola causing bad "burn-backs."

After the final metal has been drawn, keep on the blast, but at a reduced pressure to burn out the coke, and shut down. To clean the cupola, break out the breast hole and rake out the ashes and slag with the other waste through this opening. The breast must be made up for each run. Provision must be made, of course, for carrying off the sparks, fumes, etc., from the top of the cupola, and some sort of ventilator or chimney should be used.