No. 705,640. Patented July 29, 1902.

E. T. BRADFORD, Dec'd.

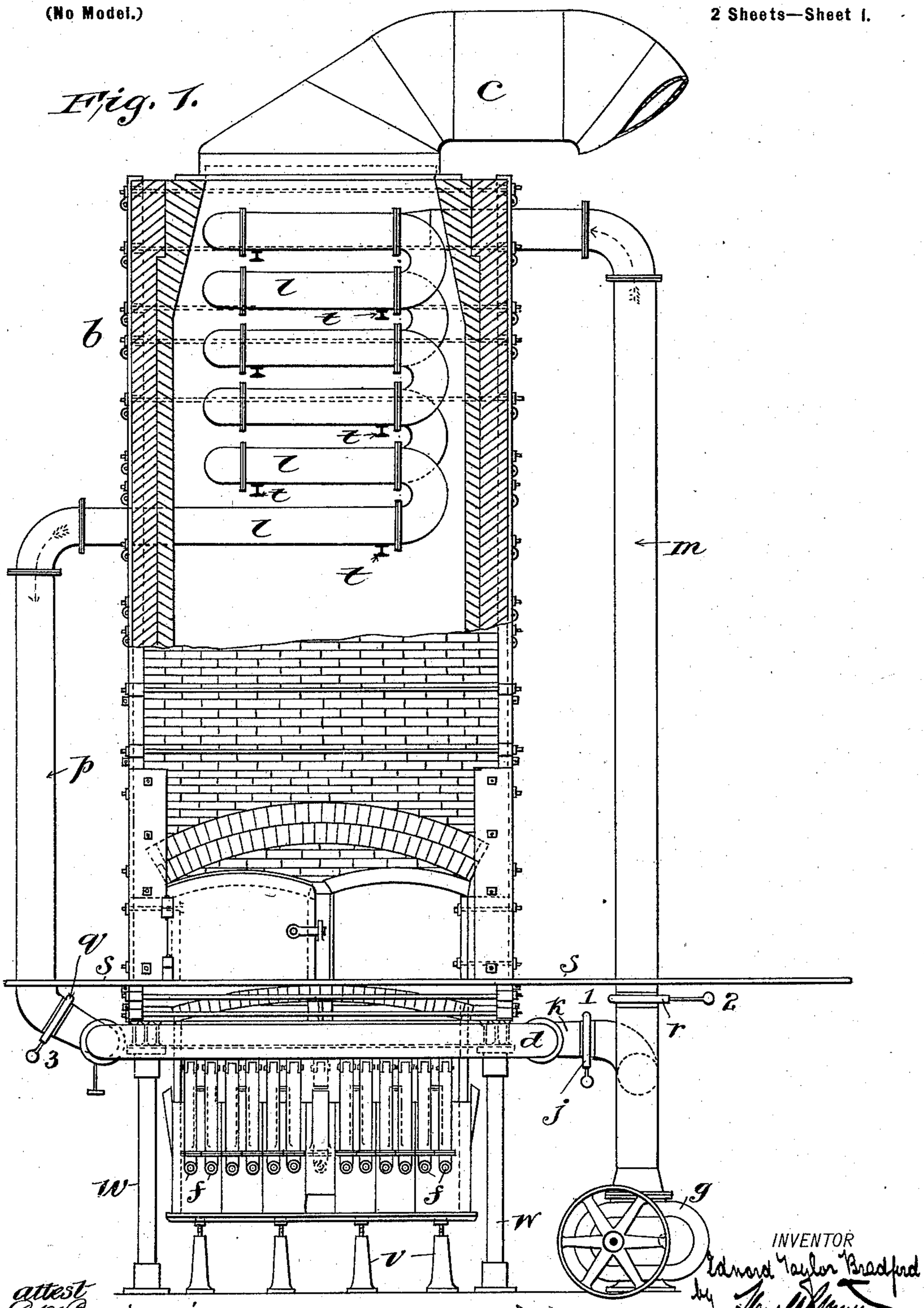
M. C. C. BRADFORD, Administratrix.

HOT BLAST FURNACE.

(Application filed July 7, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



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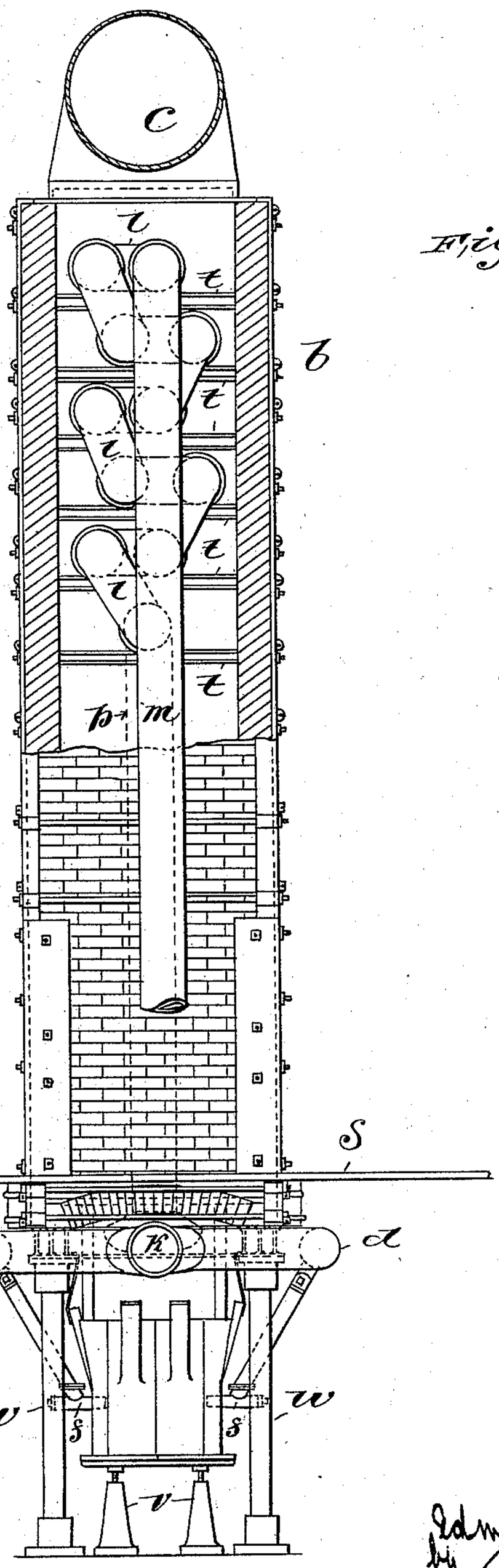

Fig. 2.

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UNITED STATES PATENT OFFICE.

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HOT-BLAST FURNACE.

SPECIFICATION forming part of Letters Patent No. 705,640, dated July 29, 1902.

Application filed July 7, 1900. Serial No. 22,811. (No model.)

To all whom it may concern:

Be it known that I, EDWARD TAYLOR BRADFORD, of Denver, Colorado, have invented certain new and useful Improvements in Hot-Blast Furnaces for Smelting Pyritic Ores and other Uses, of which the following is a specification, illustrated by the accompanying drawings.

The invention is an improvement in the hot-blast apparatus for such furnaces; and the principal objects of the invention are increased economy in the operation of the furnace, in the constructing and repairing it, and in increased durability.

The greater economy of a hot-blast furnace as compared with cold-blast furnaces is now generally recognized. It is said in Peter's *Modern Copper Smelting*, edition of 1898, page 422, that temperatures of not more than 305° Fahrenheit show "a decided improvement over a cold blast in the running of a furnace. Besides exercising a more energetic oxidizing action, and thus facilitating the process in general, the tendency of a hot blast is to concentrate the heat more in front of the twyers and to avoid the agglutination of the charge higher up. At the same time, as the furnace-column may then be lower, the volatile action of sulfur is more effectually sublimated or prevented from condensing, while that part of it which seems to go down, even to the vicinity of the twyers, is also burned. The temperatures of the blast used vary from 600° to 1,200° Fahrenheit. So far as the working of the furnace itself is concerned, there is no limit." Several plants have been installed in which the blast has been heated by separate stoves fired by additional fuel; but this involves the expense of such extra fuel and equivalent amount of coke which might otherwise be added to the furnace charge. If, however, the blast be heated solely by the hot waste gases from the furnace, then the heating of the blast involves no additional expense for fuel. As a general rule the greater the amount of sulfur contained in the amount of fuel the less will be the amount of coke required in the charge, and with the blast heated to 500° to 600° Fahrenheit there should be no difficulty in using as little as three per cent. of coke in the charge for the furnace when the economical apparatus which forms the subject of this present invention is employed.

In the accompanying drawings, Figure 1 is an elevation of a furnace embodying the present invention, partly in section and partly broken away to show the interior construction. Fig. 2 is another elevation at right angles to Fig. 1, showing the same furnace and also partly broken away to expose the interior construction.

The hood or upper portion of the furnace is marked *b*, the pipe leading to the dust-chamber and chimney or stack is marked *c*, the bustle-pipe for feeding the twyers is marked *d*, and the twyers *f*. The blower, of any suitable type, is shown at *g* and a direct cold-air connection from the blower to the bustle-pipe *d* is shown at *h*, provided with a valve *j*. This connection permits the regulation of the temperature of the hot-blast furnace by introducing more or less cool air direct from the blower. The heater-pipes *l* for the hot blast are placed in the upper portion or hood of the furnace, so as to be exposed directly to the heated gases passing up from the charge in the furnace. The air is supplied from the blower *g* through the pipe *m* to the upper or cooler end of these heating-pipes *l*, while the lower end of these heating-pipes, which is most directly exposed to the flames and heat of the furnace, is connected by a pipe *p*, provided with a controlling-valve *q* with the bustle-pipe *d*. The essential feature of this construction is that the cool air passes from the pipe *m* into the cooler end of the heating-pipes, where it is exposed to the heat of the furnace-gases at some distance from the charge, and thence as the air passes down through the heating-pipes *l* it is exposed to a more and more intense heat and its temperature raised until it passes from the hottest part of the heating-pipes through the pipe *d* to the bustle-pipe and twyers. Thus the air is continually moving to a hotter portion of the

heating system and the heat is transmitted to the air through the pipes very uniformly throughout the length of the pipes *l*, in distinction to being introduced cold into the hottest ends of the pipes and passing gradually to the cooler portions. If the capacity of the heating-pipes is sufficiently great, the air will be carried to the twyers at approximately the temperature of the hottest portion of the entire heating system—namely, that portion which approaches most nearly to the charge that is being smelted. In order to give a still greater economy of heat, the walls of the furnace above the charge-floor, which is indicated at *s*, are constructed of or heavily lined with fire-brick or other refractory and non-conductive material. The walls of the furnace, therefore, which surround the heating-pipes *l* become intensely hot on their inner surface and by their radiation greatly assist in the maintaining of the heating-pipes *l* at a high temperature. Preferably the pipes *l* are made of short sections of cast-iron piping and elbows and supported on rails or bars *t*. This construction is durable and permits the ready repair or renewal of any of the parts. The crucible of the furnace and the portion beneath the charge-floor *s* may be as in any approved form of standard pyritic or matte furnace, the details of which do not directly concern the novel features of the present invention. Preferably, however, these portions are mounted upon cast-iron columns *v*. The upper portions of the furnace and the entire brickwork preferably rest on iron beams or girders, as shown, which in turn rest upon the iron columns *w*.

By the improved apparatus it will be seen that after the charge has been placed in the furnace and the combustion commenced the air for the hot blast will be drawn in by the blower *g* and forced through the valve *r*, pipe *m*, heating-pipes *l*, connecting-pipe *p*, valve *q*, and bustle-pipe *d* to the twyers *f*. If the temperature of the hot blast rises higher than is desired, the valve *j* may be partially opened to admit cool air from the blower *g* directly to the bustle-pipe *d* and twyers *f*, and thereby the temperature of the blast may be regulated at will. All the heat supplied to the blast is taken out of the hot gases from the furnace and brought back with the blast directly into the furnace. Therefore the desired temperature for the smelting process is produced with the least possible waste of heat, and consequently with the greatest economy. Furthermore, the construction is extremely simple and durable and is very accessible for repairs.

The furnace described embodies the invention in its preferred form, though the details are of course subject to considerable modification.

The novel features which I wish to protect by Letters Patent as the characteristic features of the invention are the following:

1. A hot-blast furnace, provided with blast-heating pipes, located within the furnace and arranged to conduct the blast from the upper and cooler to the lower and hotter portions of said pipes, and twyers connected to the hotter end of the said heating-pipes, a portion of said heating-pipes consisting of pairs of horizontal pipe-sections supported on transverse supports, said pairs being arranged in zigzag order, so as to economize space and more effectually intercept the rising products of combustion, and a series of U-sections secured to the said straight pipe-sections to complete the system, substantially as described.

2. A hot-blast furnace, provided with blast-heating pipes located within the furnace and adapted to conduct the blast from the upper and cooler to the lower and hotter portions of said pipes, twyers connected to the hotter end of the said heating-pipes, blower mechanism for supplying air to the cooler end of said heating-pipes, and a non-conducting refractory lining in the portion of the furnace surrounding the heating-pipes, a portion of the said heating-pipes within the said refractory lining consisting of series of horizontal pipe-sections arranged in zigzag order and supported on transverse supports, and a series of substantially similar U-sections provided with flanges and secured to the said horizontal sections at the said flanges; substantially as described.

3. A hot-blast furnace provided with blast-heating pipes located within the furnace and adapted to conduct the blast from the upper and cooler to the lower and hotter portions of said pipes, twyers connected to the hotter end of said heating-pipes, said pipes consisting of a series of separable horizontal flanged sections supported in pairs, flanged U-shaped connections horizontally connecting said sections in pairs at one end, and other U-shaped connections at the opposite ends of the horizontal sections connecting said horizontal sections with those above or below, the elements of said pipe structure mutually supporting each other throughout, and means for suspending the entire pipe structure within the path of the products of combustion of the furnace; substantially as described.

Signed this 2d day of July, 1900, at Denver, Colorado.

EDWARD TAYLOR BRADFORD.

Witnesses:
JOHN MCDONOUGH,
EDWARD TAYLOR.