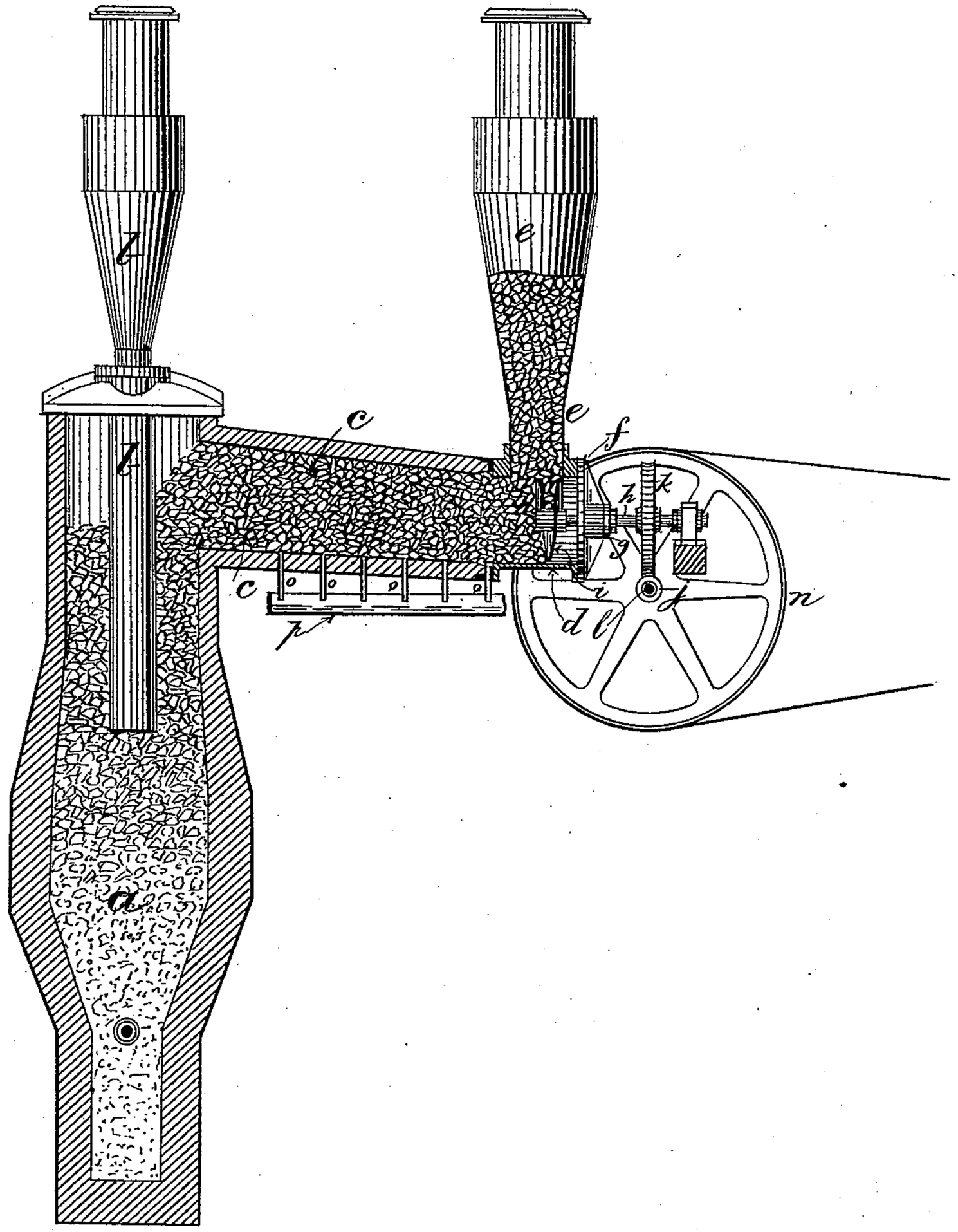
(No Model.) 2 Sheets—Sheet 1.

E. WALSH, Jr.

APPARATUS FOR CONDENSING ZINC VAPORS AND COLLECTING THE METALLIC ZINC THEREFROM.

No. 405,134. Patented June 11, 1889.

Fig. 1.



WITNESSES
J. L. Kornsby
O. L. Schrader

INVENTOR
Edward Walsh Jr. by
Paul Bakewell
his attorney

(No Model.) 2 Sheets—Sheet 2.

E. WALSH, Jr.

APPARATUS FOR CONDENSING ZINC VAPORS AND COLLECTING THE METALLIC ZINC THEREFROM.

No. 405,134. Patented June 11, 1889.

Fig. 2.

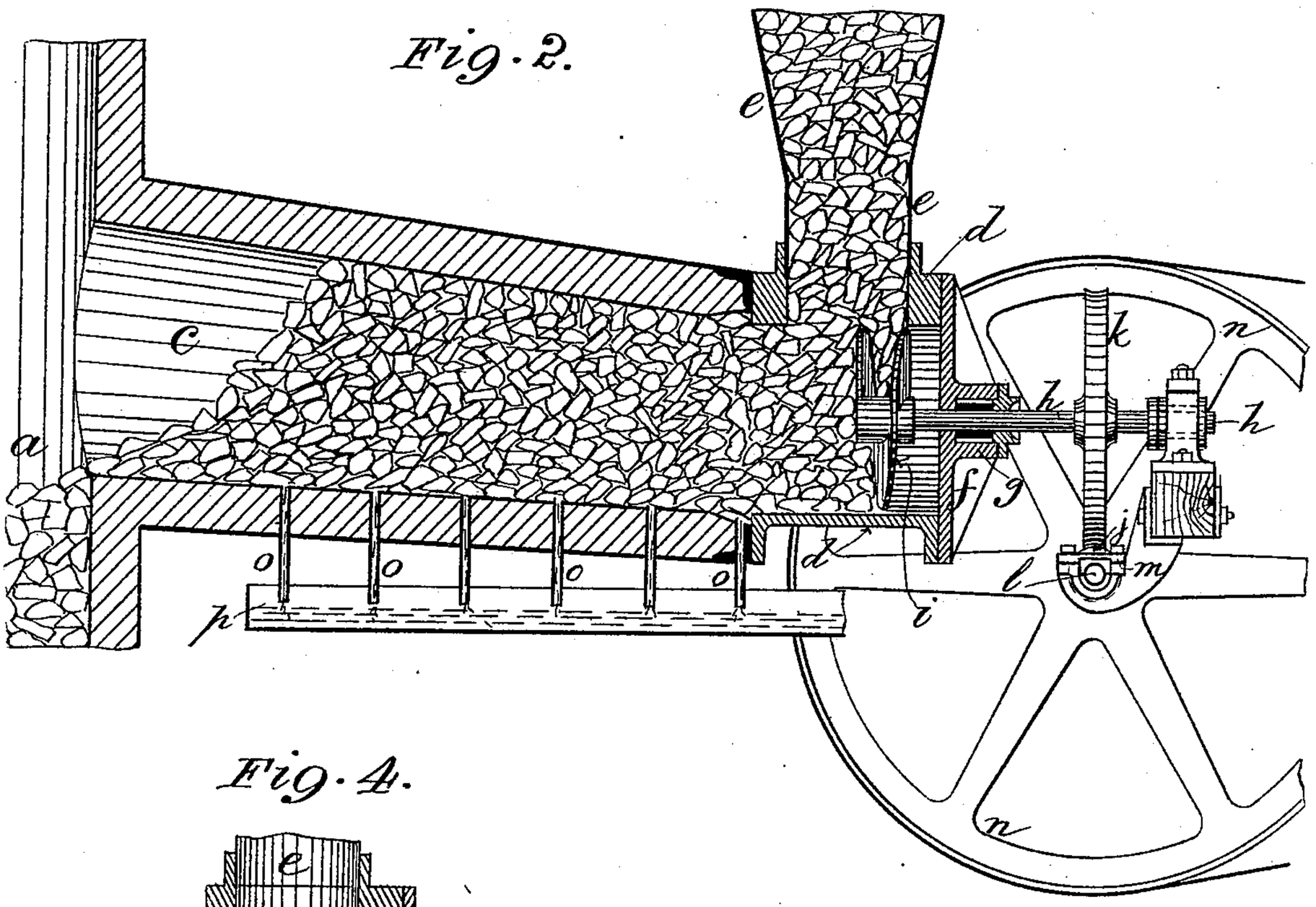


Fig. 4.

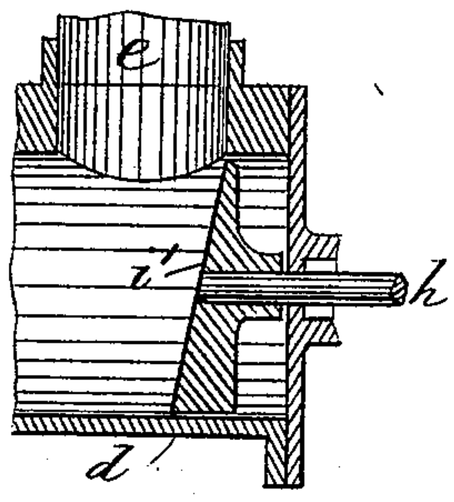
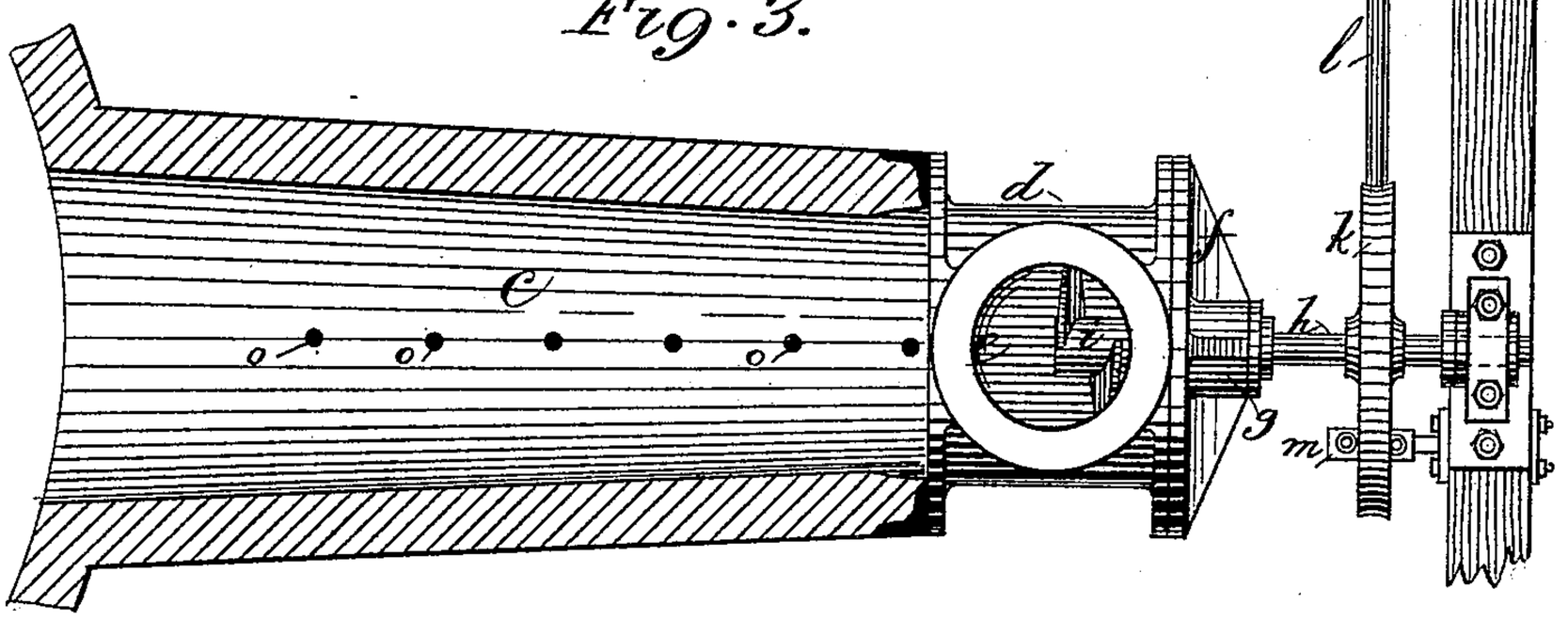


Fig. 3.



WITNESSES

J. L. Normsby

S. L. Schrader

INVENTOR

Edward Walsh Jr. by

Paul Bakewell

his attorney

UNITED STATES PATENT OFFICE.

EDWARD WALSH, JR., OF ST. LOUIS, MISSOURI.

APPARATUS FOR CONDENSING ZINC VAPORS AND COLLECTING THE METALLIC ZINC THEREFROM.

SPECIFICATION forming part of Letters Patent No. 405,134, dated June 11, 1889.

Application filed November 23, 1888. Serial No. 291,665. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WALSH, Jr., a citizen of the United States, residing at the city of St. Louis, State of Missouri, have invented a certain new and useful Improved Apparatus for Condensing Zinc Vapors and Collecting the Metallic Zinc Therefrom, of which the following is a full, clear, and exact description.

My invention relates to apparatus for condensing zinc vapors and fumes arising from the reduced oxide of zinc in a cupola-furnace and for collecting the resulting metallic zinc, and is an improvement on the means described therefor in Letters Patent granted to me, dated June 14, 1887, No. 364,979, for a discovery in the art relative to the reduction of the oxide of zinc in native or calcined zinc ores, on which subject it should be here recapitulated that "zinc oxide reduces at 1,300° Fahrenheit and the metal distills at about 100° Fahrenheit lower than that temperature. Volatilization takes place immediately on reduction of the zinc oxide. At a temperature of 1,300° Fahrenheit carbon is entirely unaffected by the action of carbonic acid, and the carbonic acid generated from the reduction of the zinc oxide is carried off with the zinc vapor at that temperature. Carbonic acid at a temperature below 1,300° Fahrenheit when mixed with zinc vapor again oxidizes the metallic zinc vapor, thereby producing an undesirable result; but I have discovered that when zinc vapor and carbonic acid, both at a temperature of between 1,400° and 1,500° Fahrenheit, or slightly in excess of that temperature, are allowed to pass through carbon or carbonaceous matter, which is also at a temperature of between 1,400° and 1,500° Fahrenheit, the carbonic acid is immediately converted into carbonic oxide, and that thus the zinc vapor does not undergo any further oxidation; that the result of thus allowing carbonic acid and zinc vapor at the temperature of between 1,400° and 1,500° Fahrenheit, or slightly in excess of that temperature, to pass through carbon or carbonaceous matter at a temperature between 1,400° and 1,500° Fahrenheit, or slightly in excess of that temperature, is to produce zinc vapor and carbonic oxide."

My present invention consists in the combination, with a cupola-furnace, in which the reduction of zinc oxide takes place, (such as the furnace described in my said patent,) of a condensing chamber or vessel projecting from the upper part of the furnace and provided at its outer end with a chute, through which carbon or carbonaceous matter is fed to the condensing-vessel; a spiral or other suitably-shaped disk (or plunger) located within the condensing-vessel behind the chute-opening therein and mounted on a shaft, to which rotation (or reciprocation in the case of a plunger) is imparted, whereby the carbonaceous matter entering through the chute is continually forced therefrom along the condensing-vessel into the furnace as the carbonaceous matter in the latter is consumed, the resultant condition being that the carbonaceous matter at the opening of the condensing-vessel into the furnace is maintained at a temperature of about 1,500° Fahrenheit, and the zinc vapor and carbonic acid arising from the reduced oxide of zinc in the furnace passes through the carbonaceous matter at the mouth of the condensing-vessel, when the carbonic acid is converted into carbonic oxide, and the zinc vapor, preserved from further oxidation, passes onward through the cooler portions of the carbonaceous matter and is condensed and precipitated in a liquid form in the lowest part of the condensing-vessel, whence it is withdrawn through pipes or passages into a trough or other suitable receiver.

On the accompanying drawings, Figure 1 represents a side sectional elevation of the apparatus comprising my invention as applied to a cupola-furnace; Fig. 2, a similar view of the apparatus detached to an enlarged scale; and Fig. 3, a sectional plan thereof, omitting the carbonaceous matter. Fig. 4 shows an alternative form of the spiral disk seen in Figs. 1, 2, and 3.

Referring to Figs. 1, 2, and 3, *a* represents the furnace into which the fuel and calcined zinc ores, mixed in such proportions that sufficient fuel is present to effect a reduction of the zinc oxide to volatilize the zinc and fuse the properly-fluxed impurities contained in the ore, are charged through the hoppers and chutes *b*. Projecting externally from and opening into the furnace *a* at its upper part is a condensing-vessel *c*, which is preferably

lined with fire-brick, and preferably of a conical form, diminishing from its opening at the furnace *a* to its outer end, and so arranged that its lower part preferably dips somewhat from the furnace *a*.

To the outer end of the condensing-vessel *c*, and forming a continuation thereof, is preferably fixed a cylinder *d*, of cast-iron or other suitable material, into which at its top portion opens a chute *e*. The cylinder *d* is closed at its outer end by a cover *f*, formed with a central stuffing-box *g*, through which passes a shaft *h*, having fixed thereto within the cylinder *d*, and of nearly equal diameter to the latter, a spiral disk *i*, the initial point of which (in the sense of its rotation) is beneath or somewhat behind the edge of the opening of the chute *e*.

Rotation is imparted to the shaft *h* by a worm *j*, which engages with a worm-wheel *k*, fixed on the shaft *h* externally to the cylinder *d*, the worm *j* being fixed on a shaft *l*, mounted in bearings *m*, and provided with a pulley *n*, which is driven by belt from any suitable motor adjacent to the apparatus; or the rotation of the shaft *h* may be effected by any other well-known mechanical arrangement, as found most convenient.

Through the lowest part of the condensing-vessel *c* are a series of passages or pipes *o*, which open below the vessel *c* into a trough *p* or other suitable conduit for the metallic zinc, as hereafter referred to.

In operation, the furnace *a* being charged with the mixed ores and fuel through the chutes *b* and the condensing-vessel *c* charged with carbonaceous matter through the chute *e*, when the mixed fuel and ore in the furnace *a* and the carbonaceous matter lying thereon at and adjacent to the opening of the condensing-vessel *c* into the furnace *a* have reached a temperature of 1,500° Fahrenheit, the zinc vapor and carbonic acid thereby generated from the reduction of the zinc oxide in the furnace *a* pass through the said portion of the carbonaceous matter into the condensing-vessel *c*, and in so doing the carbonic acid is immediately converted into carbonic oxide, which passes onward through the cooler portions of the carbonaceous matter in the vessel *c*, whereby the zinc vapor is condensed and precipitated in a liquid form to the bottom of the condensing-vessel *c*, from which it flows through the pipes *o* into the trough or other conduit *p* and along the latter in any required direction for use, while the carbonic oxide passes from the vessel *c* through the chute *e* or other pipe to waste or otherwise as required. Meanwhile the spiral disk *i*, on being slowly rotated within the cylinder *d*, continually forces the carbonaceous matter fed through the chute *e* along the condensing-vessel *c*, so that the portion of carbonaceous matter before named at the opening into the furnace *a* is maintained at the temperature of 1,500° Fahrenheit, or thereabout, necessary for converting the carbonic acid into carbonic oxide, while the temperature of the carbonaceous matter in the vessel *c* behind the said portion is heated by the gases to the proper temperature for condensing the zinc vapor, or from 1,200° to 800° Fahrenheit.

If preferred, in lieu of a spiral disk *i*, as shown in Figs 1, 2, and 3, I may use a plain circular, preferably wedge-shaped, disk *i'*, fixed at an angle with its shaft *h*, as shown in Fig. 4.

I claim—

1. A condenser for condensing zinc vapors into molten zinc, said condenser having a vapor-inlet for the admission of zinc vapors, a feed mechanism for feeding a condensing medium—such as solid carbon—through the condenser in the direction of the vapor-inlet, and outlets for the uncondensed gases and the condensed molten zinc, substantially as and for the purposes specified.

2. A condenser for condensing zinc vapors into molten zinc, said condenser having a vapor-inlet, a feed-chute distant from the vapor-inlet, feed mechanism for feeding a condensing medium—such as carbon—through the condenser, and outlets for the condensed molten zinc and uncondensed vapors, substantially as and for the purposes specified.

3. The combination, with a stack or furnace for reducing zinc ore, of a condenser arranged at the upper part thereof and connected therewith, said condenser having outlets for the escape of non-condensed gases and condensed molten zinc, a feed-chute at the distant end of the condenser, and feed mechanism for feeding a carbonaceous material through the condenser into the furnace, substantially as and for the purposes specified.

4. The combination, with a stack or furnace for reducing zinc ores, of a condensing-tunnel connected with the upper part thereof and slightly inclined therefrom, outlets at the bottom of said tunnel for the escape of condensed molten zinc, and feed mechanism for feeding a solid carbon through the tunnel and into the stack, substantially as and for the purposes specified.

5. The combination, with a stack or furnace for reducing zinc ores, said stack having a chute for charging the furnace with mixed ores and fuel, of a condensing-tunnel connected with the top of the stack, said tunnel provided with a chute for introducing carbon, feed device for feeding the carbon through the tunnel into the stack, and outlets for the escape of condensed molten zinc and non-condensed gases, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 20th day of November, 1888.

EDWARD WALSH, JR.

Witnesses:
S. L. SCHRADER,
PAUL BAKEWELL.