No. 765,299. PATENTED JULY 19, 1904.

C. W. SPEIRS.

CRUCIBLE FURNACE.

APPLICATION FILED DEC. 21, 1903.

NO MODEL. 5 SHEETS—SHEET 1.

Fig. 2

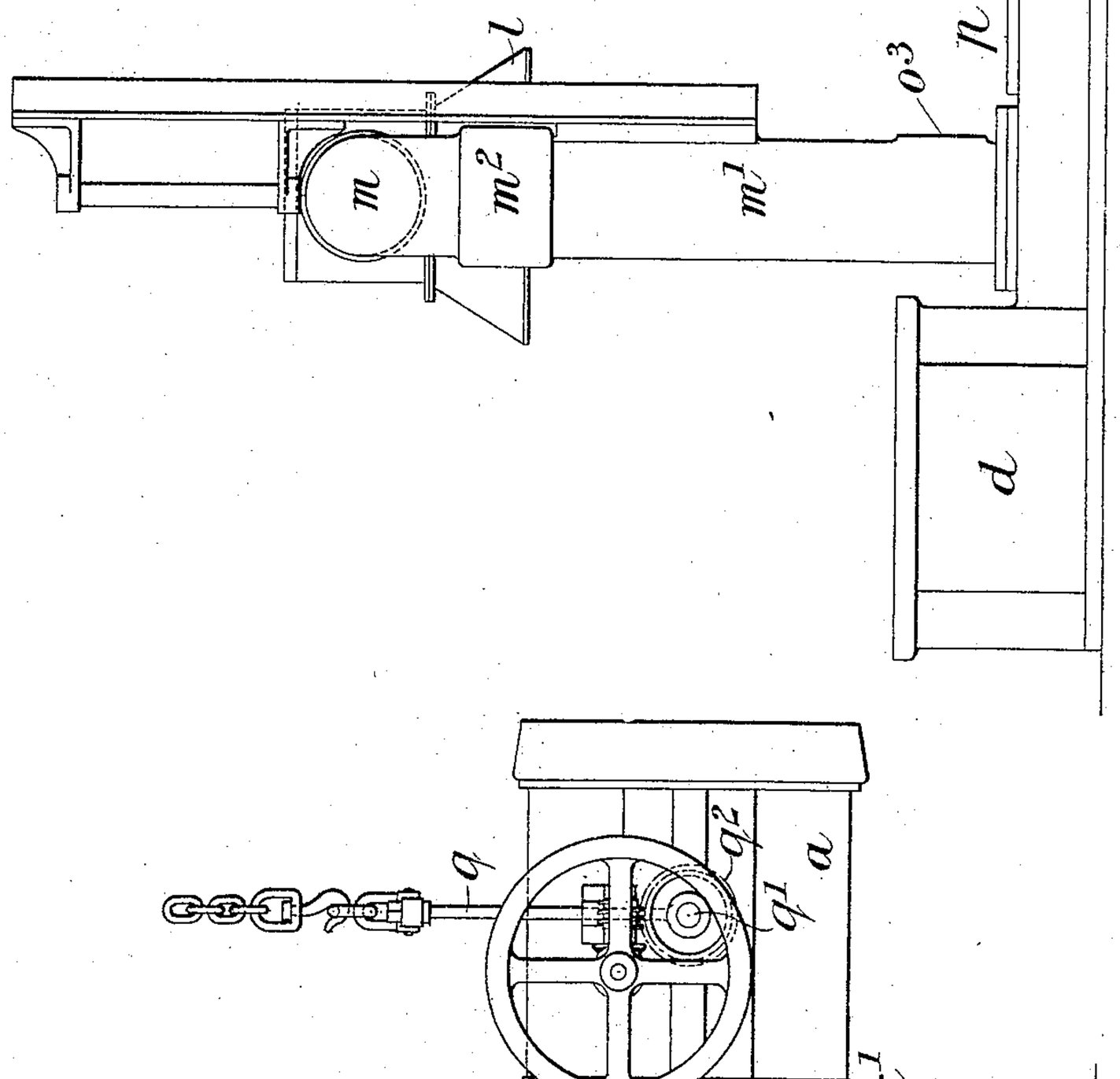
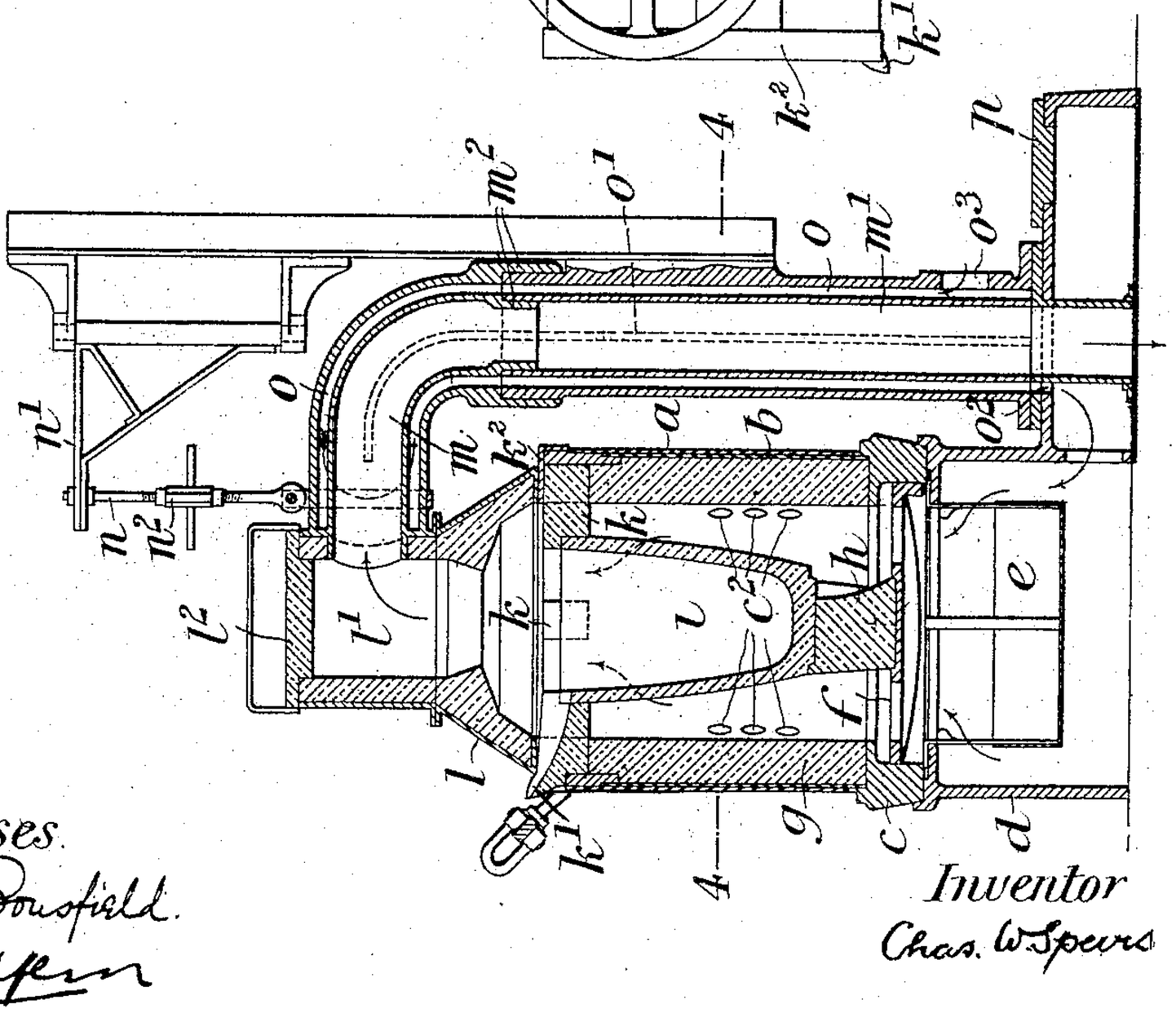


Fig. 1



Witnesses.
John E. Bousfield.
C. G. Reapen

Inventor
Chas. W. Speirs

No. 765,299. PATENTED JULY 19, 1904.

C. W. SPEIRS.

CRUCIBLE FURNACE.

APPLICATION FILED DEC. 21, 1903.

NO MODEL. 5 SHEETS—SHEET 2.

Fig. 3.

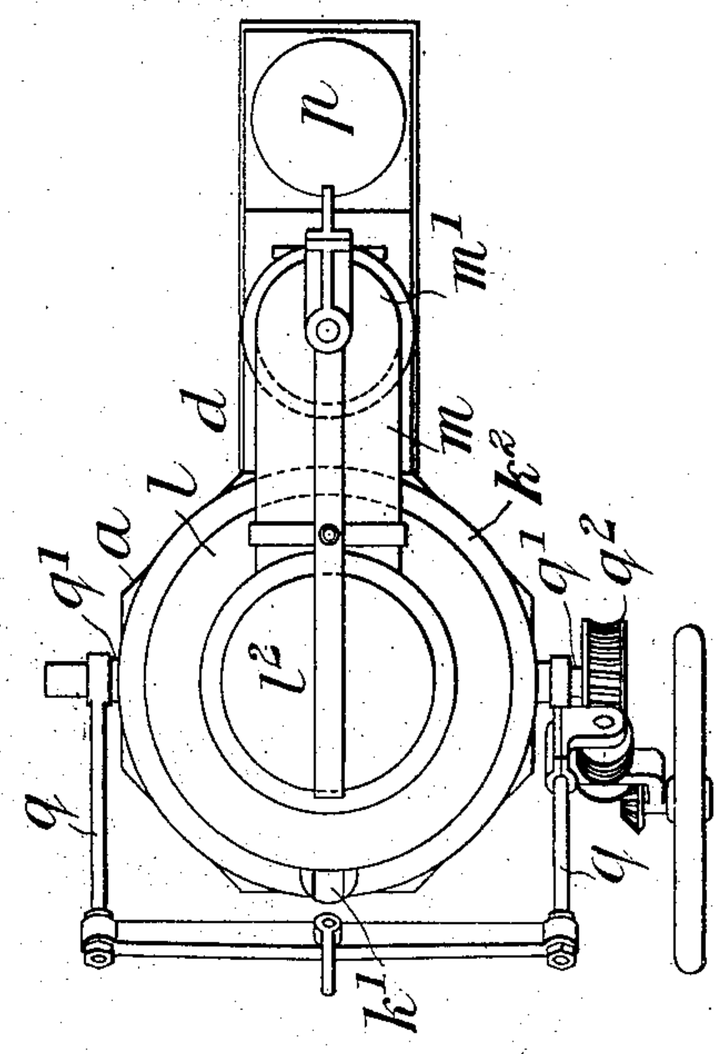


Fig. 4.

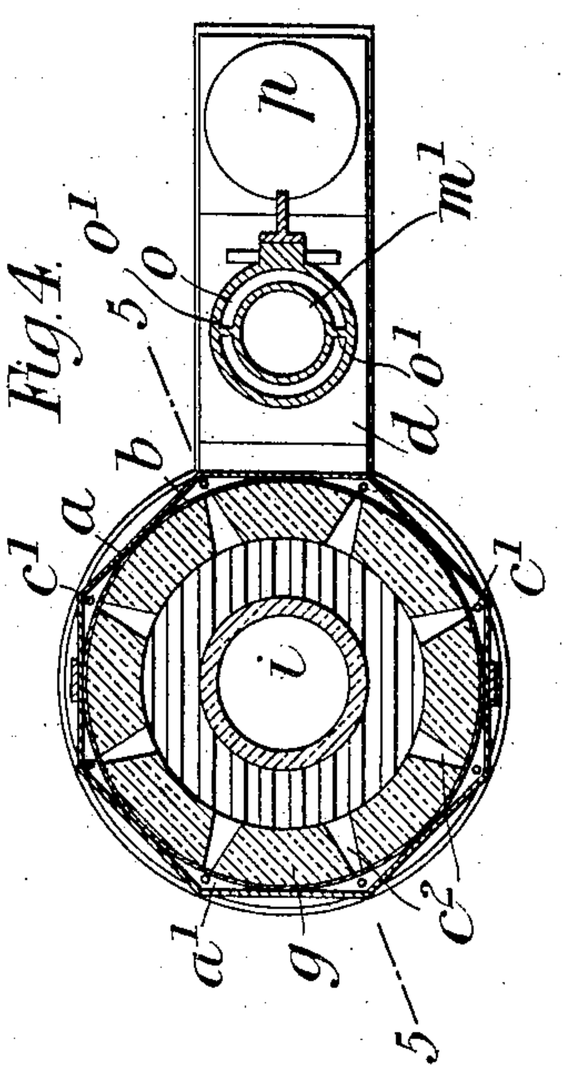


Fig. 5.

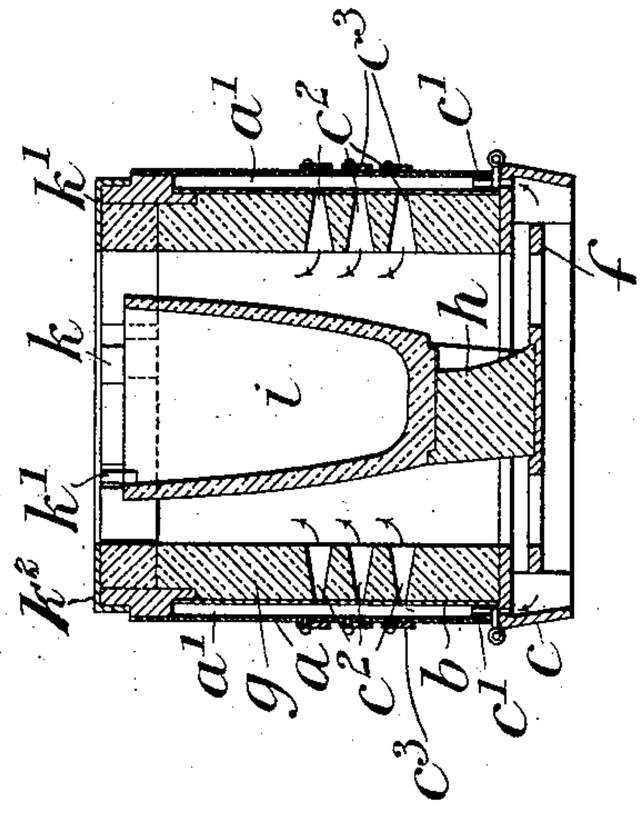
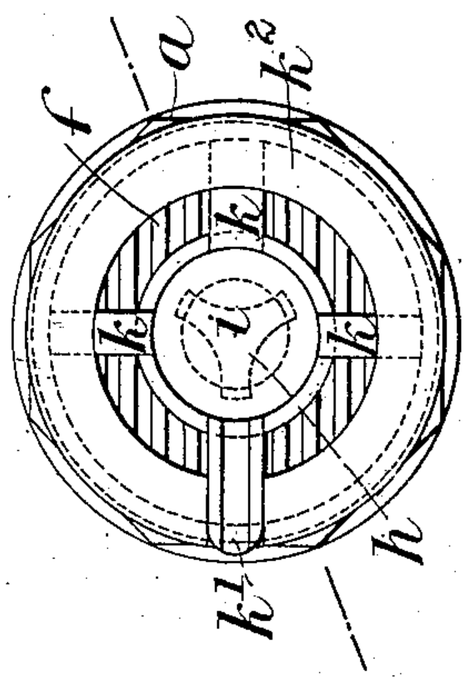


Fig. 6.



Witnesses.
John E. Bousfield.
C. G. Redfern

Inventor
Chas. W. Speirs.

No. 765,299. PATENTED JULY 19, 1904.

C. W. SPEIRS.

CRUCIBLE FURNACE.

APPLICATION FILED DEC. 21, 1903.

NO MODEL. 5 SHEETS—SHEET 3.

Fig. 8.

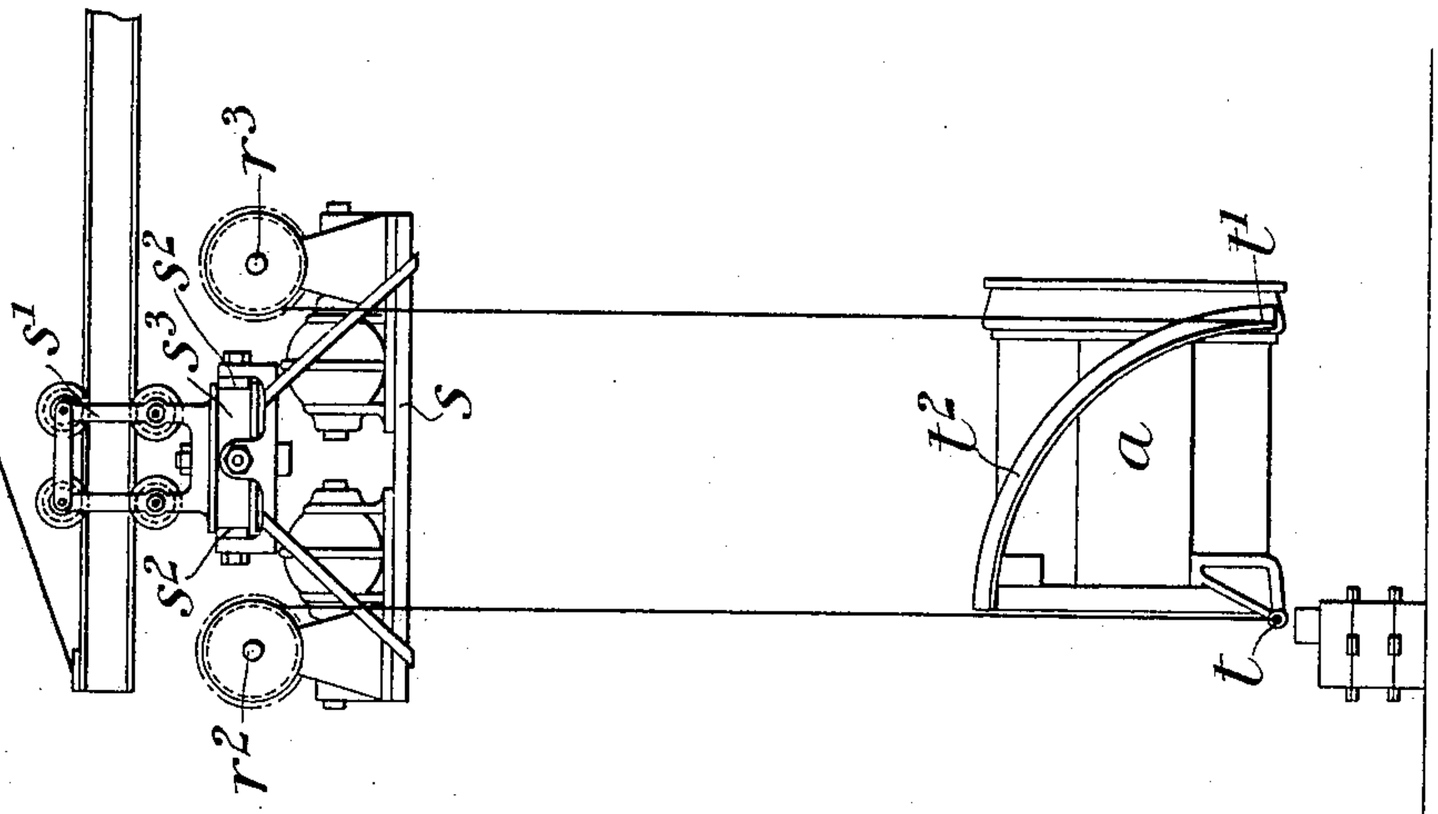
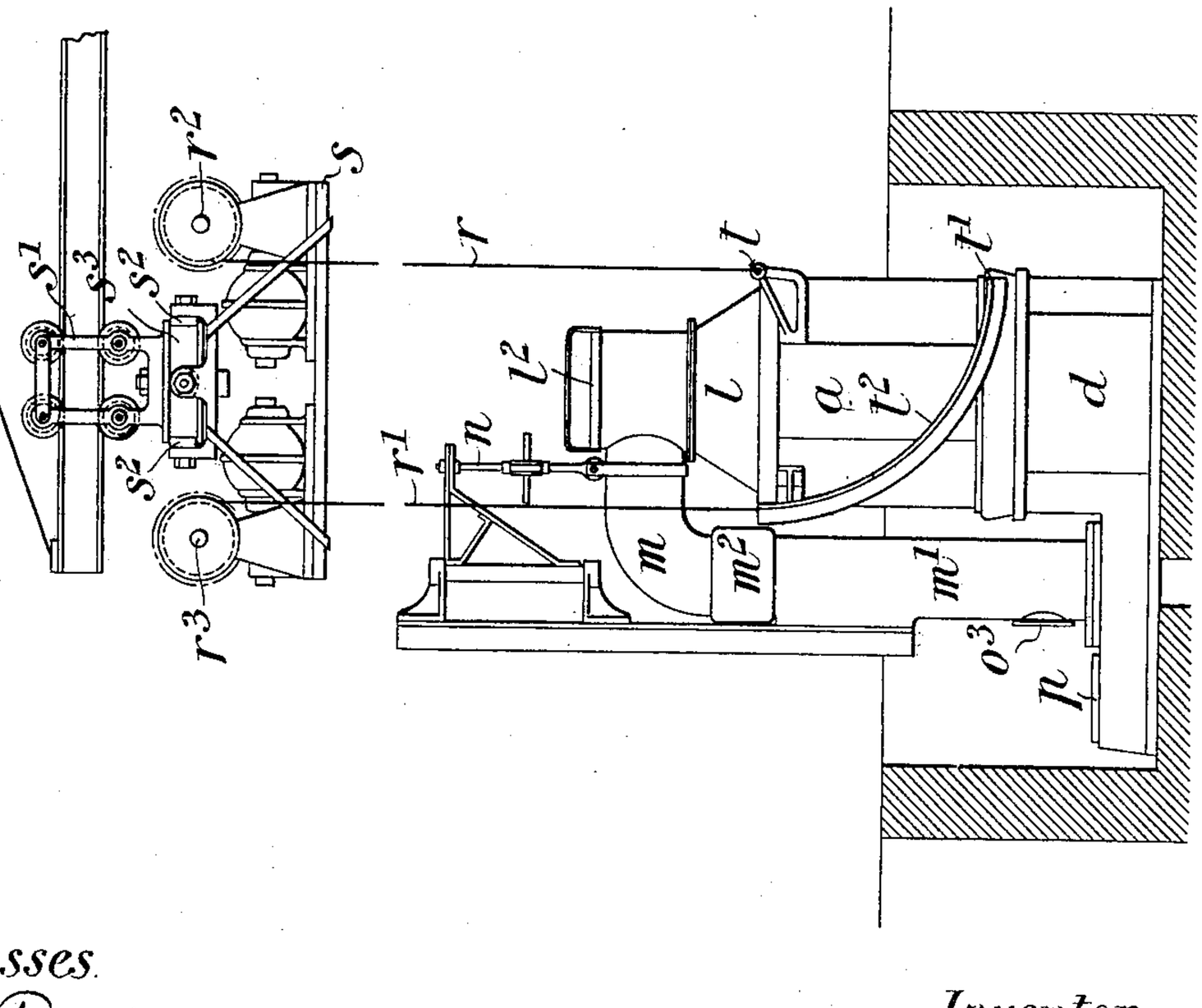


Fig. 7.



Witnesses.
John E. Bousfield.
C. Kaiser

Inventor.
Chas. W. Speirs.

No. 765,299. PATENTED JULY 19, 1904.

C. W. SPEIRS.

CRUCIBLE FURNACE.

APPLICATION FILED DEC. 21, 1903.

NO MODEL. 5 SHEETS—SHEET 4.

Fig. 10

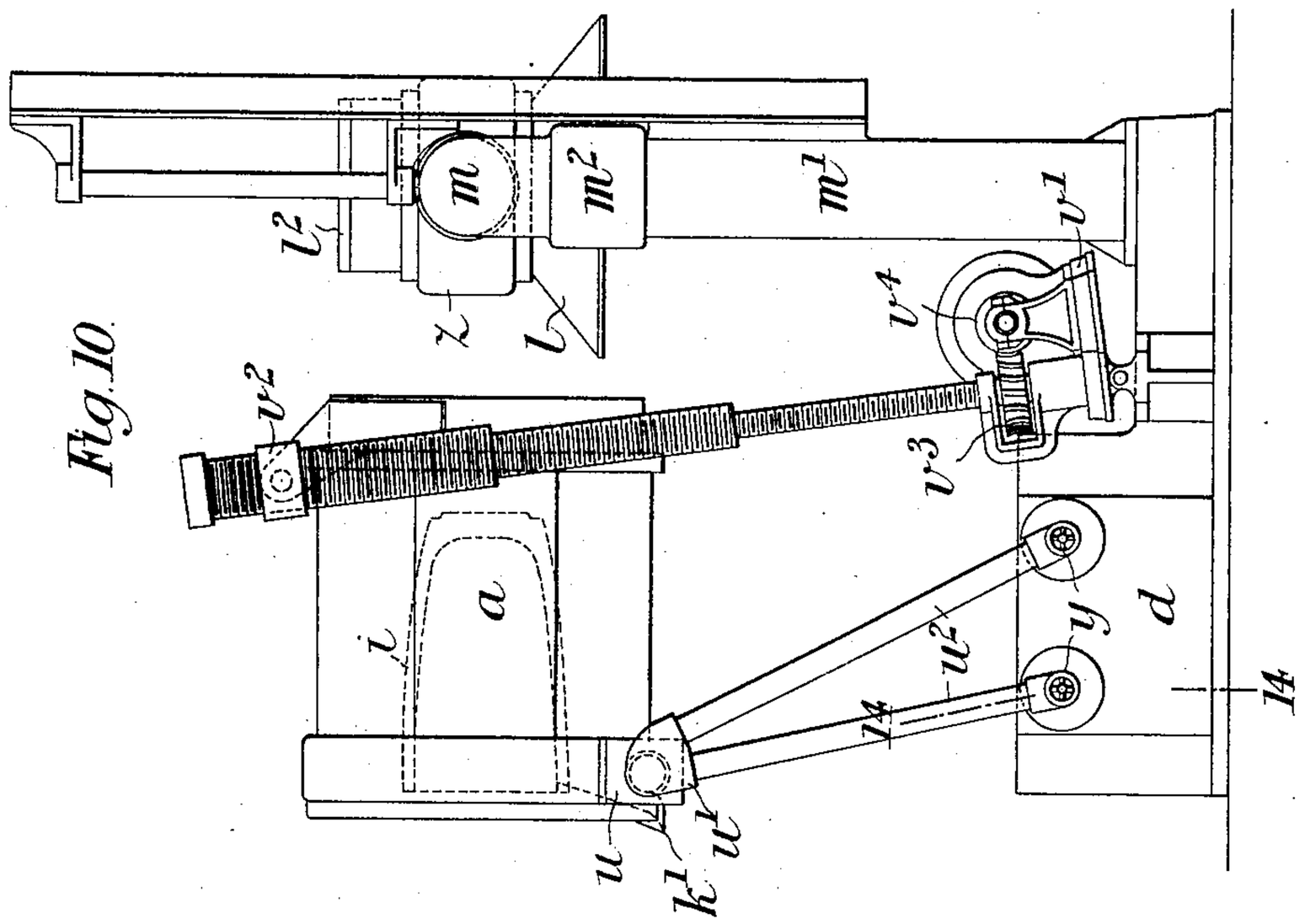
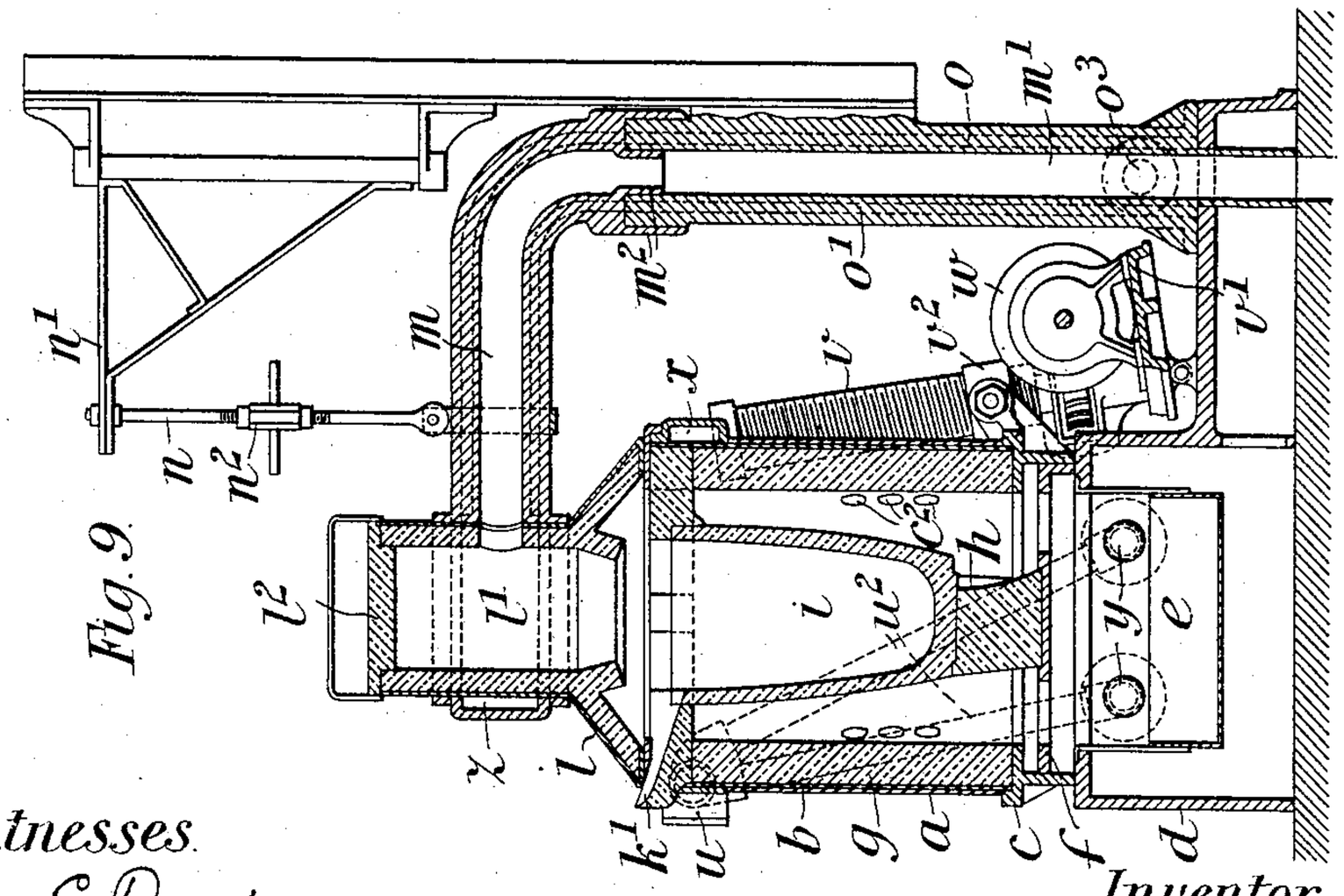


Fig. 9



Witnesses.
John E. Bousfield.
C. G. Redfern

Inventor.
Chas. W. Speirs

No. 765,299. PATENTED JULY 19, 1904.

C. W. SPEIRS.

CRUCIBLE FURNACE.

APPLICATION FILED DEC. 21, 1903.

NO MODEL. 5 SHEETS—SHEET 5.

Fig. 12.

Fig. 15.

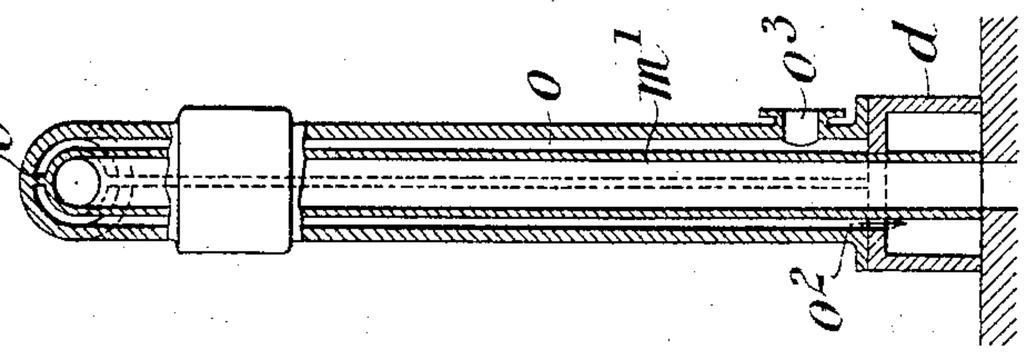


Fig. 13.

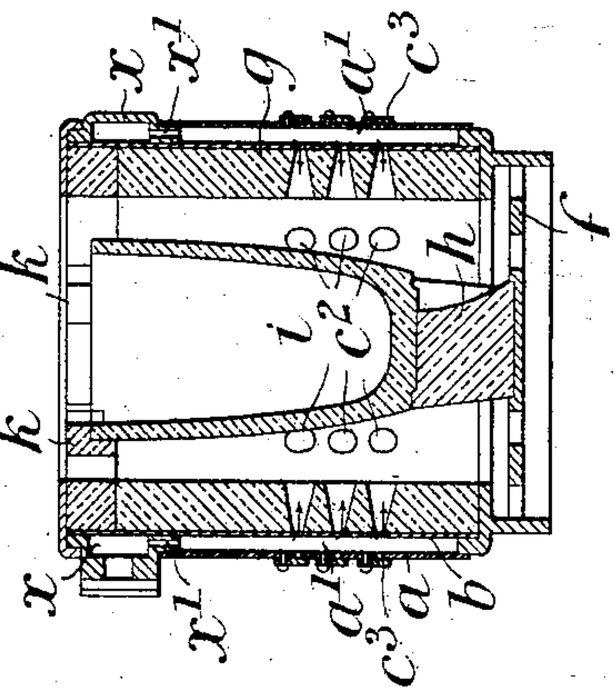


Fig. 14.

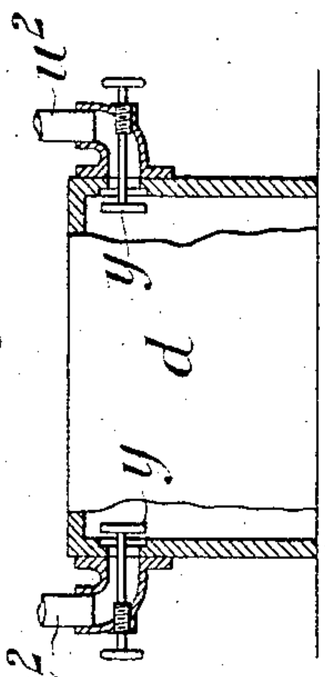
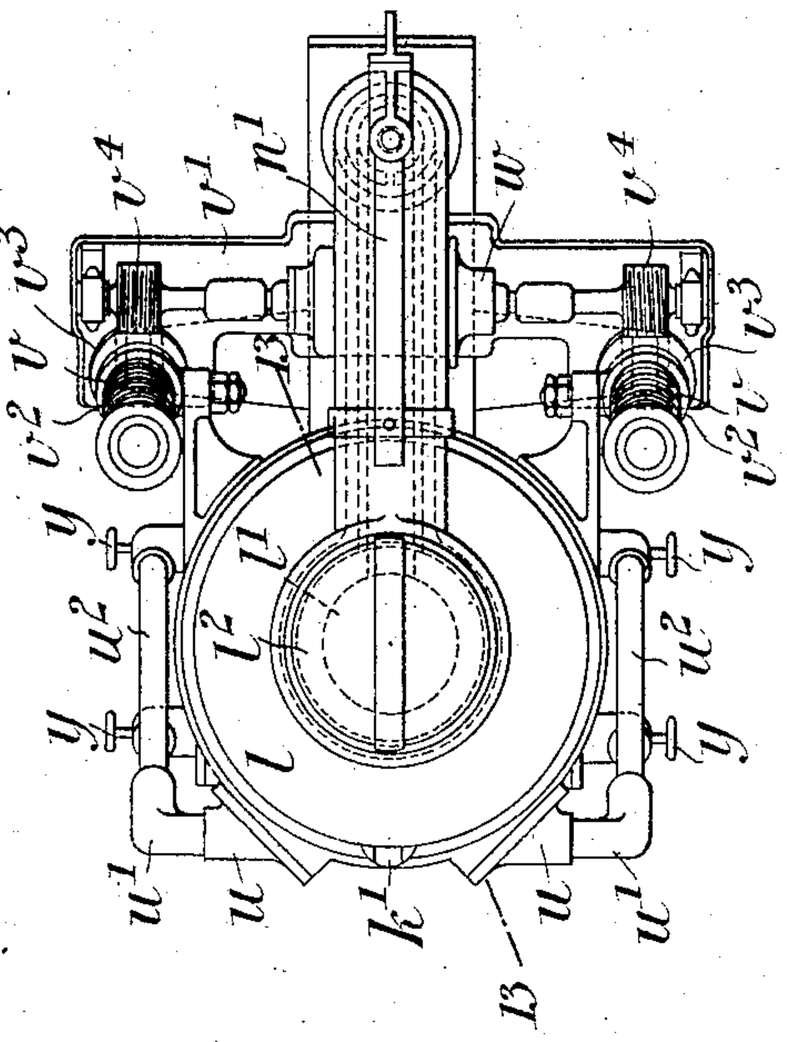


Fig. 11.



Witnesses.
John E. Bousfield.
C. Reafsnyder

Inventor.
Chas. W. Speirs

No. 765,299. Patented July 19, 1904.

UNITED STATES PATENT OFFICE.

CHARLES WILLIAM SPEIRS, OF BATTERSEA, LONDON, ENGLAND, ASSIGNOR TO THE MORGAN CRUCIBLE COMPANY, LIMITED, OF BATTERSEA, LONDON, ENGLAND.

CRUCIBLE-FURNACE.

SPECIFICATION forming part of Letters Patent No. 765,299, dated July 19, 1904.

Application filed December 21, 1903. Serial No. 185,994. (No model.)

To all whom it may concern:

Be it known that I, CHARLES WILLIAM SPEIRS, a subject of the King of Great Britain, residing at Battersea Works, Battersea, London, England, have invented new and useful Improvements in Crucible-Furnaces, of which the following is a specification.

My invention relates to crucible-furnaces of the kind adapted to be tilted for the purpose of discharging the molten contents of the crucible without removing the same from the furnace, the objects of my invention being to provide improved means for supporting the crucibles in the furnace, to improve the combustion in the furnace, to retain the external parts of the furnace relatively cool, and to prevent as far as possible the escape of the products of combustion into the chamber or building in which the furnace is situated.

My improvements can be applied to furnaces designed to be tipped or tilted on an axial line passing transversely through the spout or to furnaces adapted to be operated in the ordinary manner.

In the accompanying drawings, Figure 1 is a sectional side elevation of a portable furnace constructed according to my invention and adapted to be tilted upon trunnions in the usual manner, and Fig. 2 is a side elevation showing the parts in a different position. Fig. 3 is a plan view of the furnace shown in Fig. 1, and Fig. 4 is a section on the line 4 4, Fig. 1. Fig. 5 is a section on the line 5 5, Fig. 4; and Fig. 6 is a plan view of the furnace proper, shown in Fig. 5. Fig. 7 shows a furnace of the kind illustrated in Figs. 1 to 6, also portable, but wherein the furnace proper is adapted to be tilted upon an axis passing transversely through the spout; and Fig. 8 is a view illustrating the furnace shown in Fig. 7 in a tilted position. Figs. 9 and 10 are views similar to Figs. 1 and 2, respectively, but illustrating a modification in the construction of the furnace in which the body is fixed to the stand and in the means for tilting the same upon an axis passing transversely through the spout. Fig. 11 is a plan view showing the parts in the position in which they appear in Fig. 9. Figs. 12, 13, 14, and 15 are details, hereinafter described, of the arrangement shown in Figs. 9 to 11.

According to the invention the furnace proper is contained in a metal casing composed of an external shell *a* of polygonal shape and an internal shell *b* of circular shape, so that a series of passages *a' a'* is formed between the two shells, as shown in Figs. 4 and 5. By this construction a very strong metallic casing may be formed by using two comparatively thin metallic shells, the one reinforcing the other, and providing the vertical air-passages without any supplemental constructions. These shells when lined with refractory material will also be protected to a large extent from the heat of the furnace, and the air-currents passing between them will receive heat from both of them and assist in maintaining them in a relatively cool condition. This casing is secured to a base-ring *c*, adapted to stand on a closed base-plate *d*, inclosing an ash-pit *e*, and carries the grate *f* and the brick or other refractory lining *g* of the furnace. The ring *c* has also formed in it a series of holes or apertures *c' c'*, Figs. 4 and 5, through which air can enter the passages *a'*, and a series of holes c^2 c^2 is formed through the inner shell *b* and through the refractory lining *g* into the furnace, so that the air can enter the furnace not only directly through the grate *f*, but also through the passages *a' a'*, which air tends to keep the external shell *a* of the furnace relatively cool.

In practice the holes c^2 c^2 of the furnace are larger on the inner face of the lining than at the points where they communicate with the passage or passages *a'*, so as to permit of the said holes being more or less filled with slag without affecting the air-supply, which does not depend on the size of the hole in the clay lining of furnace, but on the size of the hole in the steel lining which supports the clay lining, and therefore unless the holes in

the clay lining become smaller than the holes in the steel lining the draft is not affected. Holes c^3 c^3 in the shell a are provided so that a poker or rod may be inserted to clear away any ash from the holes c^2 c^2, the said holes being normally covered by shutters.

Within the furnace upon the grate f is mounted a stand or support h, upon which the crucible i is carried. In practice the grate f is advantageously made in three portions, the center one of which carries the support h, while the two side pieces are removable to facilitate the cleaning of the furnace. Upon the top of the lining g is placed a series of supporting bricks or arms k k, Figs. 5 and 6, which engage with the top of the crucible and support it in its proper position relatively with the furnace when the latter is tipped. In one of the arms k is a spout k', through which the molten metal is discharged, and the apertures between the said arms serve for the escape of the gases of combustion and for the introduction of fuel into the furnace around the crucible.

Upon the top edge of the furnace is a plate k^2, having flanged edges which fit around the top of the furnace and serve to retain the arms k k in position, the said plate also forming a seat upon which the top portion l of the furnace will rest, which top portion for convenience of description is hereinafter referred to as a "cover." It will be noticed that the joint between this cover and the body of the furnace is practically in the same plane as the top of the crucible, this arrangement facilitating the charging of the crucible and the skimming of the metal.

The cover l, which is provided with a refractory lining, has in it a chamber l', open at the bottom immediately above the crucible and having a removable cover l^2, the said chamber being connected by a pipe m with the down-pipe m', extending to a flue or chimney. This chamber l' allows of the scrap metal being piled up above the crucible to a considerable extent, so that as the metal melts it will gradually drop down into the crucible, the heated gases escaping from the furnace passing through that portion of the scrap metal remaining in the chamber and heating the same before it enters the crucible, thereby facilitating the melting operation.

The pipe m is connected to the down-pipe m' by a spigot and socket-joint m^2 to permit of turning the cover away from the top of the furnace, for instance, as shown in Fig. 2, so as to allow of the lifting and tilting of the furnace proper.

In order to relieve the joint m^2 of any strain which would tend to retard the movement of the cover and also to provide for slightly lifting the cover from the top of the furnace without breaking the joint, the said cover and swivel-pipe m are suspended by an adjustable link n from a small swinging arm or derrick n', the center of movement of which is in alinement with the center of the joint m^2. The link n is formed with a nut n^2, having right and left hand screw-threads engaging with corresponding threads on the parts of the link, so that by rotating the said nut n^2 more or less the desired lifting movement of the cover l and its connecting parts can be effected.

In order to promote the combustion in the furnace, I provide for passing the air necessary for supporting the combustion over the pipe m', so that it shall be heated, and to permit of this I form the said pipes m and m' with double walls to form an annular passage o. This annular passage is divided by partitions o', as clearly shown in Figs. 1 and 4, which partitions extend nearly up to the walls of the chamber l'. The lower end of one half of this annular passage communicates with the base d at o^2, Fig. 1, while the other half is cut off from communication with the base, but is open to the atmosphere through the aperture o^3. It will thus be understood that the air which is forced through the aperture o^3 into the annular passage o passes up around one half the pipe m' and descends around the other half of the pipe into the base d, whence it passes into the furnace in the direction of the arrows indicated in Fig. 1 and also into the passages a' in the casing and thence into the furnace. The air which passes through the passages a', although heated, tends to keep the walls of the furnace much cooler than would be the case if such passages were not provided.

It is to be understood that the base d is normally closed, so that the only air which enters is that which is forced in around the flue-pipe. One or more covers or doors, such as p, Figs. 1 to 4, are, however, advantageously formed in the base to afford access to the interior of the latter. If the furnace is to work with natural draft, the cover or covers p can be removed to admit air.

The furnace shown in Figs. 1 to 3 is provided with a yoke q, attached to trunnions q' q', and is provided with worm-gearing q^2 for tipping the furnace.

It will be understood that when the cover l is removed from above the furnace the latter can be lifted from its base to discharge the contents of the crucible, as shown in Fig 2.

As shown in Figs. 7 and 8, the furnace instead of being adapted to be lifted by means of a yoke and trunnions, as last described, is adapted to be lifted by two pairs of chains or ropes r r', Fig. 7, the pair of chains r r being adapted to be wound upon pulleys on a shaft r^2, and the pair of chains r' r' onto pulleys on the shaft r^3, which shafts r^2 r^3 are driven by separate motors mounted upon a platform s, carried by a carriage s', the connection between the platform s and the carriage s' being effected by means of a series of rollers s^2, run-

ning in a groove s^3, so that the platform s can be rotated around an axis. This arrangement permits of the furnace when lifted being turned to any position.

The chains r are connected to the furnace on an axis t, passing transversely through the spout, and the chains r' are connected to the furnace at the lower end, as at t', and run around segment-bars t^2. These segmental bars are curved to a radius equal to the distance between the ropes when the furnace is suspended horizontally and are so fixed that the centers of the circles of which they are segments pass through the transverse axis upon which the furnace is to be tilted. It will be understood that when both the electric motors are turned simultaneously the furnace will be lifted and maintain its vertical position and that when the chains r' are lifted, while the chains r remain at rest, the furnace will be tipped upon the axis t. This arrangement permits of bringing the spout of the furnace into close proximity to the mold to be poured before tipping the furnace, as indicated in Fig. 8.

Another arrangement for tipping the furnace is illustrated in Figs. 9 to 15. In this arrangement the casing is provided near its upper part with hollow brackets $u\,u$, into which nozzles $u'\,u'$, carried by tubular stays $u^2\,u^2$, secured to the base d, project, the said nozzles forming journals or pivots upon which the furnace can be oscillated. The position of the sockets $u\,u$ and pivots $u'\,u'$ is such that the axial line of the said pivots will pass transversely through or substantially through the mouth of the spout k', through which the molten metal is discharged from the crucible. The tilting of the furnace is effected through the medium of a pair of telescoping screws $v\,v$, one of which is shown detached and in partial section in Fig. 12. These screws are at the lower end mounted on a tilting platform v' and engage with nuts v^2 at the lower part of the furnace-casing. At their lower ends the said screws carry worm-wheels $v^3\,v^3$, with which worms $v^4\,v^4$ on the shaft of an electromotor w, carried by the platform v', engage, whereby when the motor is caused to rotate rotary motion will be imparted to the said screws $v\,v$ and so oscillate the furnace, for instance, as shown in Fig. 10. The object of employing the telescoping screws is to avoid the necessity for using long screws, which would interfere with the removal of the cover l from the top of the furnace.

The worms v^4 are provided with screw-threads of opposite hands, whereby opposite thrusts on the shaft of the motor w are produced, which neutralize one another. It will be obvious that instead of employing a motor any suitable arrangement of mechanism operated by hand or otherwise can be used for tilting the furnace. When this mode of tilting the furnace is made use of, I advantageously modify the arrangement for introducing the air into the channels a' in the casing—that is to say, instead of forming the apertures c' at the lower ends of the said passages, as shown in Fig. 5, I form a passage x around the upper part of the casing, as shown in Fig. 13, (which is a vertical section of the furnace on the line 13 13, Fig. 11.) This passage x communicates with the passage a' through the channels x', and air is introduced from the base d into the passage x through the stays or standards $u^2\,u^2$, which are made hollow, as also are the brackets u and pivots $u'\,u'$.

In order to control the amount of air which passes through the grate and through the passages $a'\,a'$, valves $y\,y$ are sometimes arranged in the base d in connection with the tubular stays $u^2\,u^2$, as clearly shown in Fig. 14, which is a section on the line 14 14, Fig. 10.

It will be understood that by means of these valves the quantity of air which passes through the stays $u^2\,u^2$ to the furnace can be readily controlled. In this modification is also shown the annular passage o around the pipes m and m', extended through a passage z around the chamber l' in the cover l. In this case the partition o' in the annular passage o instead of being arranged transversely, as shown in Fig. 4, is arranged vertically, as shown in Fig. 15, which is a vertical transverse section through the said down-pipe.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a furnace, the combination with a casing comprising two metallic shells, the one being polygonal and the other circular in cross-section, and one being fitted within the other and thereby forming vertical air-passages, the inner shell being provided with perforations communicating with said vertical air-passages, of a refractory lining within said inner shell having apertures therein adapted to register with those in said inner shell, substantially as described.

2. In a furnace, the combination with a casing comprising an exterior metal shell polygonal in cross-section, and an interior metallic shell circular in cross-section fitted within the outer shell and thereby forming vertical air-passages adjacent to the angular portions of the polygonal shell, said inner shell being provided with apertures communicating with said vertical air-passages, of a refractory lining for said casing provided with apertures registering with those in the inner shell, substantially as described.

3. In a furnace, the combination with a casing comprising an exterior metal shell polygonal in cross-section, and an interior metallic shell circular in cross-section fitted within the

outer shell and thereby forming vertical air-passages adjacent to the angular portions of the polygonal shell, said inner shell being provided with apertures communicating with said vertical air-passages, of a refractory lining for said casing provided with apertures registering with those in the inner shell, said outer shell being provided with apertures in line with the apertures in the inner shell and lining and movable closing devices for said apertures, substantially as described.

4. In a furnace, the combination with a removable furnace-body, a support for the same, a laterally-movable cover provided with a chamber, into which the metal to be melted may be charged, a removable lid for said chamber, and a smoke-flue connected with said chamber, substantially as described.

5. In a furnace, the combination with a removable furnace-body, of a laterally-movable cover having a vertically-disposed pivotal connection, a laterally-movable pivoted supporting device for said cover connected therewith and having its axis of pivoting substantially concentric with the axis of pivoting of the cover, substantially as described.

6. In a furnace, the combination with a removable furnace-body, of a laterally-movable cover, a vertically-disposed smoke-flue for the furnace, a connection between said cover and said smoke-flue, pivotally connected to said flue, a vertical pivotal connection for said movable cover having its axis coinciding with the longitudinal axis of said flue and a support for said cover having a pivotal connection with a stationary part, the axis of said pivotal connection being substantially coincident with the axis of said flue, substantially as described.

7. In a furnace, the combination with the removable furnace-body provided with a casing, having air-passages formed therein, and provided with apertures communicating with the interior of the furnace, a crucible-support at the lower end of the furnace-body, a crucible supported thereby, separated devices at the upper end of the furnace engaging the crucible, the body of the crucible between its ends being entirely exposed to the fire in the furnace, a laterally-movable cover for said furnace provided with a vertical chamber in line with the crucible, a removable lid for said chamber, a smoke-outlet for said chamber, a smoke-flue pivotally connected with said smoke-outlet, a pivoted cover-support having its axis of pivoting substantially coincident with the axis of pivoting of said smoke-outlet with said flue, devices for moving said furnace-body and devices for tilting the same and means for supplying air to said air-passages in the casing, substantially as described.

8. In a furnace, the combination with the movable furnace-body, comprising a metallic casing having air-passages therein discharge-apertures on the inner side of said casing communicating with the interior of the furnace, and a passage at the upper end of said casing communicating with said air-passages, a hollow base for supporting said furnace, hollow standards connecting said base with said passage at the upper end of the furnace-body and pivotally connected with the furnace-body to form a pivotal support on which it can be tilted and means for supplying air to said base, substantially as described.

9. In a furnace, the combination with the movable furnace-body, comprising a metallic casing having air-passages therein, discharge-apertures on the inner side of said casing communicating with the interior of the furnace, and a passage at the upper end of said casing communicating with said air-passages, a hollow base for supporting said furnace, hollow standards connecting said base with said passage at the upper end of the furnace-body and pivotally connected with the furnace-body to form a pivotal support on which it can be tilted, means for supplying air to said base and mechanism for elevating the lower end of said furnace, substantially as described.

10. In a furnace, the combination with the movable furnace-body, comprising a metallic casing having air-passages therein, discharge-apertures on the inner side of said casing communicating with the interior of the furnace, and a passage at the upper end of said casing communicating with said air-passages, a hollow base for supporting said furnace, hollow standards connecting said base with said passage at the upper end of the furnace-body and pivotally connected with the furnace-body to form a pivotal support on which it can be tilted, means for supplying air to said base, elevating mechanism for the lower end of the furnace-body comprising telescoping screw-threaded devices, and actuating mechanism therefor, substantially as described.

11. In a furnace, the combination with the movable furnace-body, comprising a metallic casing having air-passages therein, discharge-apertures on the inner side of said casing communicating with the interior of the furnace, and a passage at the upper end of said casing communicating with said air-passages, a hollow base for supporting said furnace, hollow standards connecting said base with said passage at the upper end of the furnace-body and pivotally connected with the furnace-body to form a pivotal support on which it can be tilted, means for supplying air to said base and valves for controlling the supply of air to said air-passages, substantially as described.

12. In a furnace, the combination with the movable furnace-body, comprising a metallic casing having air-passages therein, discharge-apertures on the inner side of said casing communicating with the interior of the furnace, and a passage at the upper end of said casing communicating with said air-passages, a hol-

low base for supporting said furnace, hollow standards connecting said base with said passage at the upper end of the furnace-body and pivotally connected with the furnace-body to form a pivotal support on which it can be tilted, means for supplying air to said base and valves controlling the passage of air through said hollow standards, substantially as described.

CHARLES WILLIAM SPEIRS.

Witnesses:
JOHN E. BOUSFIELD,
C. G. REDFERN.