

March 2, 1937.

J. SCHMELLER, SR

2,072,650

METHOD FOR METALWORKING

Original Filed April 30, 1930 4 Sheets-Sheet 1

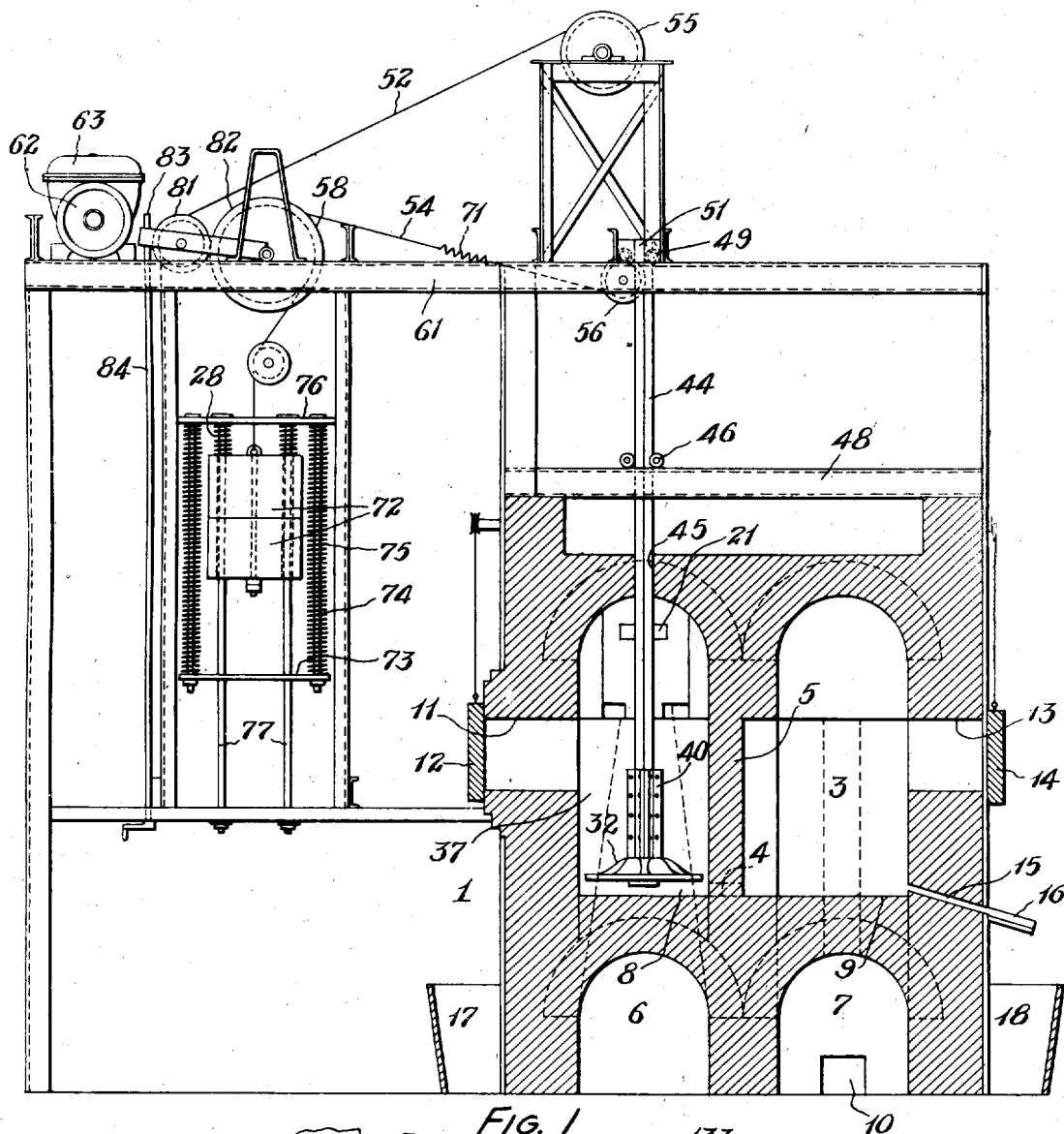


FIG. 1

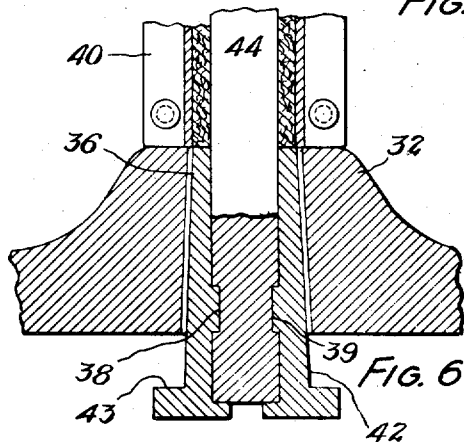


FIG. 6

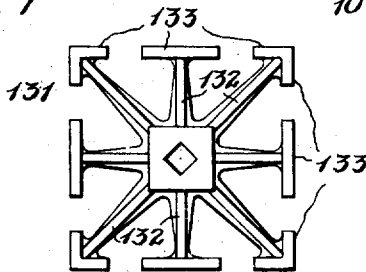


FIG. 10

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Original Filed April 30, 1930 4 Sheets-Sheet 2

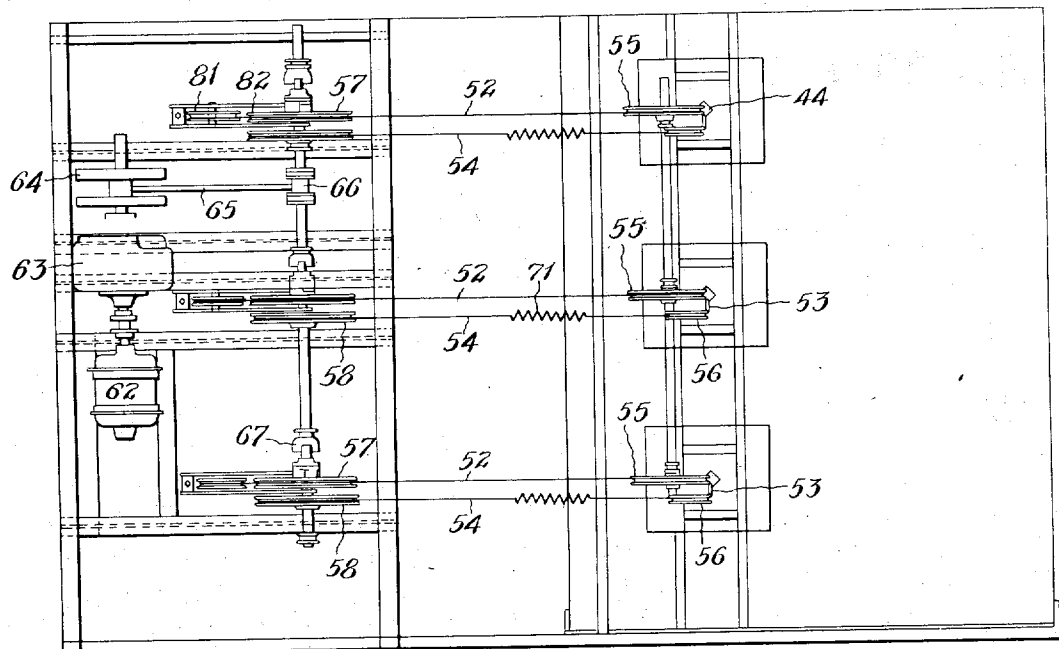


FIG. 2

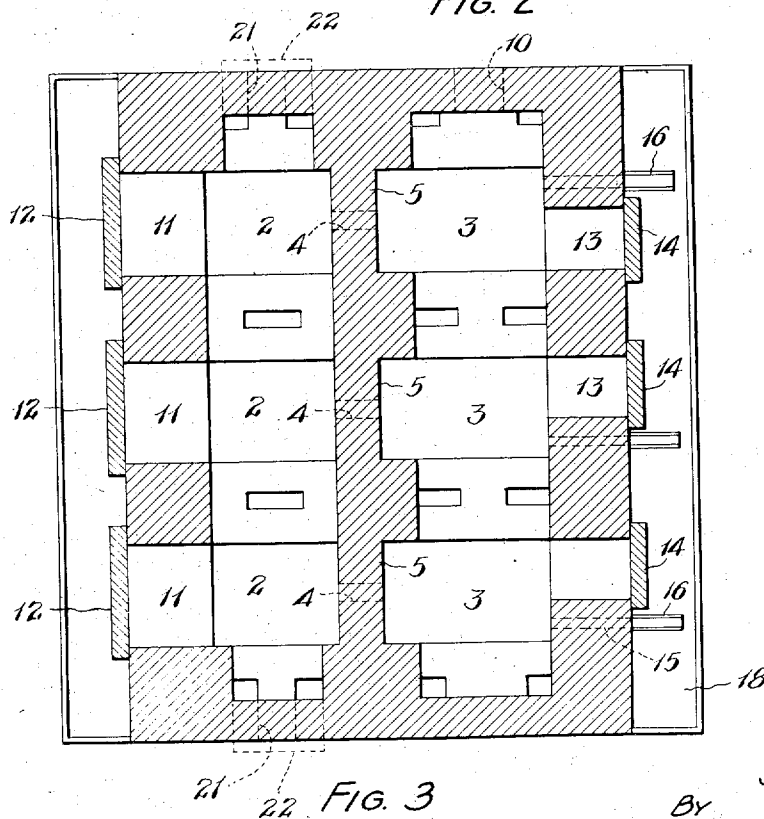


FIG. 3

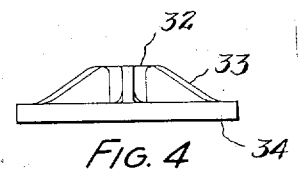


FIG. 4

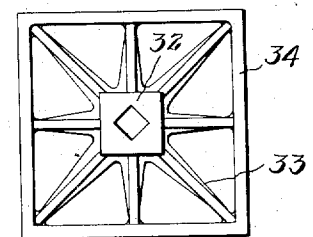


FIG. 5

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METHOD FOR METALWORKING

Original Filed April 30, 1930 4 Sheets-Sheet 3

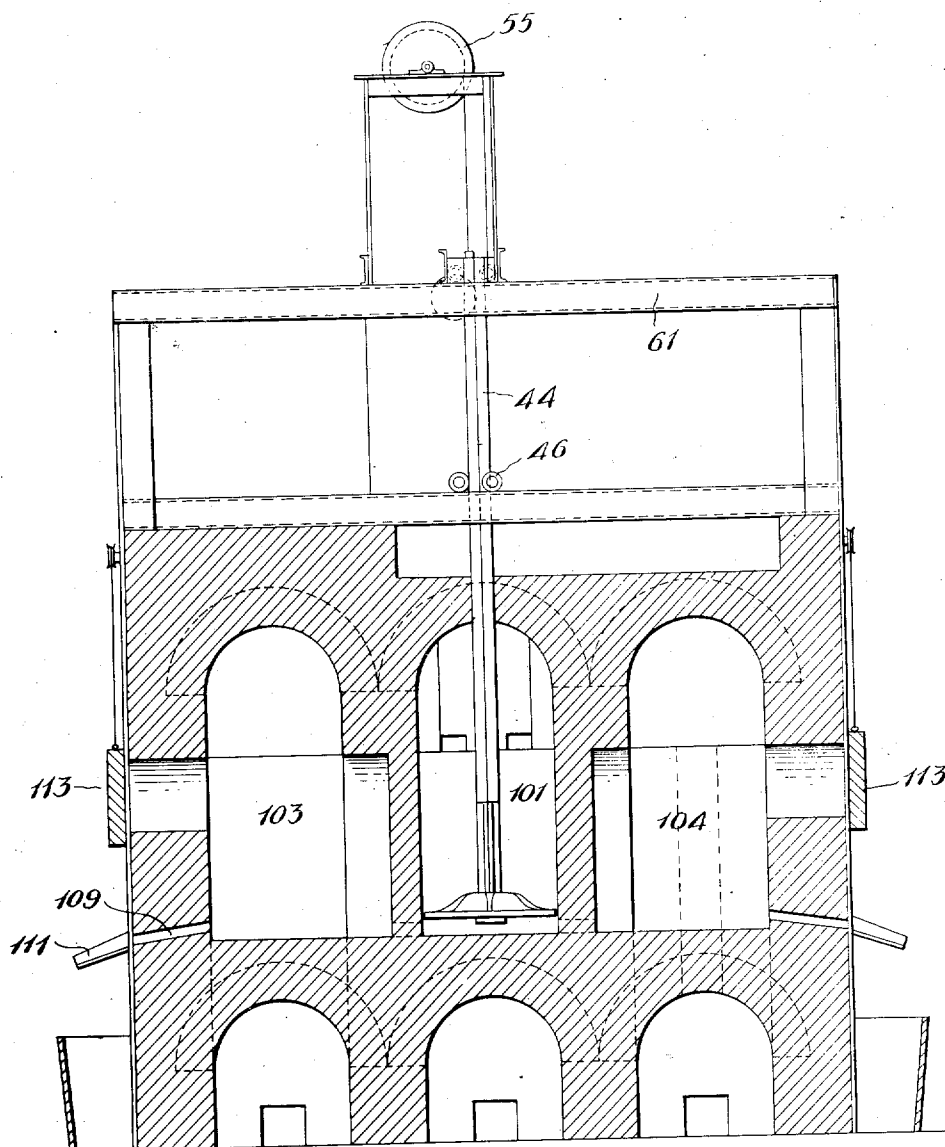


FIG. 7

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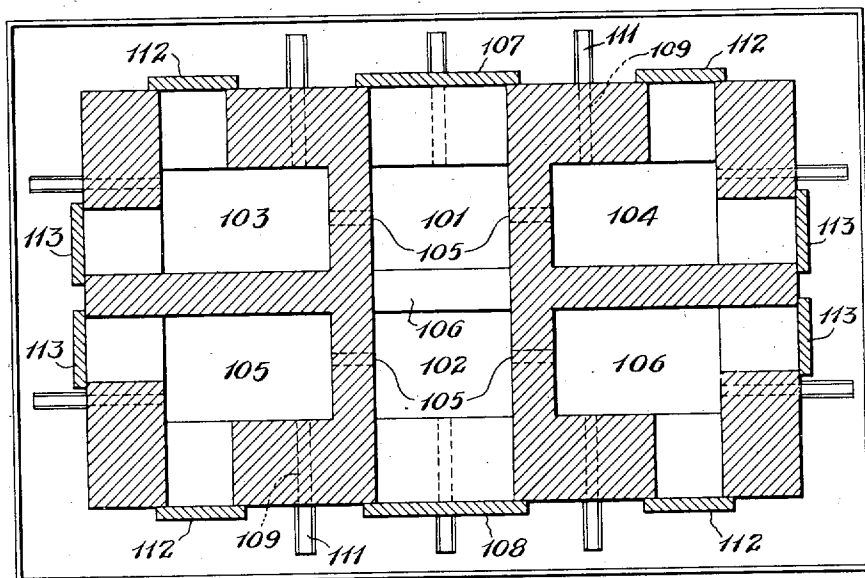


FIG. 8

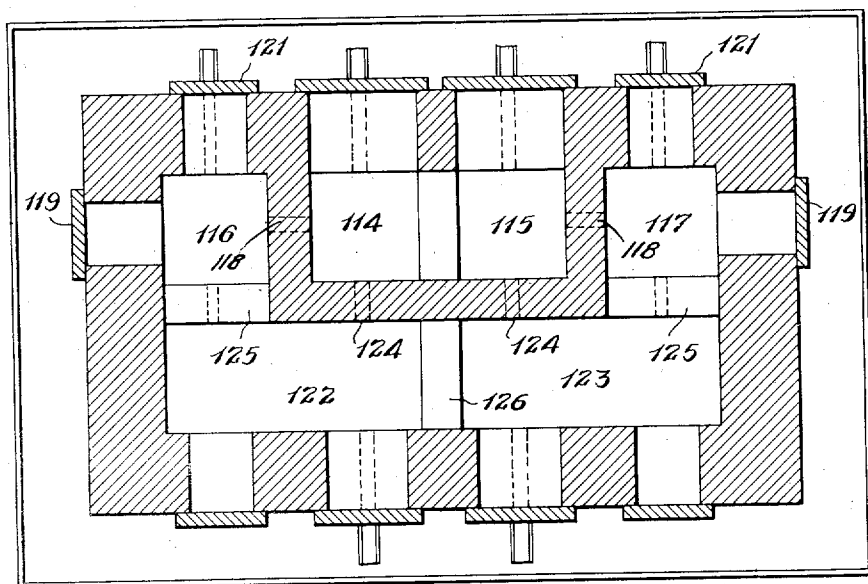


FIG. 9

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UNITED STATES PATENT OFFICE

2,072,650

METHOD FOR METALWORKING

John Schmeller, Sr., Lakewood, Ohio, assignor to
Schmeller Holding Company, Cleveland, Ohio,
a corporation of Ohio

Original application April 30, 1930, Serial No.
448,740. Divided and this application Febru-
ary 12, 1934, Serial No. 710,808

5 Claims. (Cl. 75-68)

This invention, as indicated, relates to a meth-
od for metal working and product resulting there-
from. This application is a division of my ap-
plication Serial No. 448,740, filed April 30, 1930.
5 More particularly, the invention relates to the
method of working metal while in a molten condi-
tion in a furnace chamber, in such manner
that the same may be deoxidized and mechan-
ically worked upon so as to improve the grain
10 and fiber of the metal, free the same from im-
purities and entrapped particles of foreign mat-
ter, and improve the density and physical char-
acteristics of the final product. The apparatus is
especially adapted for the remelting of secondary
15 material and preparing the same in a single con-
tinuous operation for fabrication into articles of
high quality. It may be used particularly with
such metals as are readily oxidized, such as
aluminum, but is also suitable for the treatment
20 of other metals and may be used to advantage in
the formation of alloys of various character. It
is readily adaptable for use with aluminum or
alloyed borings, turnings, sawings, filings, skim-
mings, drosses, or the like, and may be used with
25 material such as this for producing metal suit-
able for commercial fabrication into castings as
a single continuous operation. The material may
be cast into ingots, if desired, or may be fed back
through the furnace chambers after withdrawing
30 from the casting side of the furnace with any
desired addition of material necessary to form a
predetermined alloy. The method includes the
reworking of aluminum stock of finely divided
character such as is known commercially as "sal-
35 vage" or "secondary" metal which stock frequent-
ly is mingled with oils and greases and particles
of iron, and often includes material heavily oxi-
dized. The invention is disclosed in connection
with a furnace with agitating mechanism. To
40 the accomplishment of the foregoing and related
ends, said invention, then, consists of the method
and product hereinafter fully described and par-
ticularly pointed out in the claims.

The annexed drawings and the following de-
45 scription set forth in detail certain means and
one mode of carrying out the invention, and one
product resulting therefrom, such disclosed
means, mode and product illustrating, however,
50 but several of various applications of the prin-
ciple of the invention.

In said annexed drawings:

Figure 1 is a side elevation partially in section
of a furnace installation embodying the principle
55 of my invention;

Figure 2 is a top plan view of the apparatus
shown in Figure 1;

Figure 3 is a sectional plan view of the furnace
proper;

Figure 4 is a side elevation of the grid;

Figure 5 is a top plan view of the grid;

Figure 6 is an enlarged sectional detail view
showing the grid attaching means;

Figure 7 is a side elevation partially in section
of a modified type of a furnace somewhat similar
10 to that shown in Figure 1, wherein a communi-
cating chamber is provided on each side of an
agitating chamber;

Figure 8 is a plan view, partially in section, of
the apparatus shown in Figure 7;

Figure 9 is a plan view of a modified form of
furnace structure; and

Figure 10 is a top plan view of a modified form
of grid.

As is clearly shown in Figures 1 and 3 of the
drawings, the furnace 1 comprises a brick struc-
20 ture formed of piers and arches and providing
for each furnace unit, two closed furnace cham-
bers 2, 3, separated by a heavy brick wall and
communicating with each other through a small
25 conduit 4 adjacent the floor of said chambers.
The reservoir sections of said furnace unit are
shown as of substantially equal size although the
proportions may be varied in accordance with
special requirements or with the character of the
30 stock and the rate of use of the product or other
conditions. At a point above the level of the
molten metal in said chambers, charging and
skimming doors are provided.

While a single furnace unit might be provided,
35 it has been found more economical to construct
three or more furnace units in series in a single
structure, as shown, which may be simultane-
ously operated by a crew of workmen more econom-
ically than a single furnace unit or a series of
40 independent furnaces. Likewise the operating
mechanism for a series of furnace units may be
more economically installed and the heat losses
may be proportionately reduced. In the draw-
ings, therefore, I have illustrated three furnace
45 units in series. The units are each operatively
distinct from the others and a different alloy may
be run in each chamber.

Each of said units is divided centrally by a
partition wall 5 so as to provide on one side a
50 combined charging and agitating chamber 2
through which the metal stock is fed into the
furnace and on the opposite side with a heating
chamber 3 for the reception and temperature
control of the casting supply of molten metal. 55

The dividing wall 5 preferably extends from the ground to the roof of the furnace. Beneath each of the series of chambers 2, 3, arched heating chambers 6, 7, extend. The floors 8, 9, of the communicating chambers 2, 3, rest upon these arches and are packed with ganister or other heat resisting material, and the walls of said chambers are formed of or lined with fire-brick. Where a series of three furnace units is provided, it is found more economical of fuel to have the division walls between the several charging sections and likewise the walls between the several casting sections extend only to a point slightly above the side doors so that the gases in the upper part of the furnace on the respective sides of the dividing wall 5 may travel freely into any one of the three adjacent charging chambers or the three adjacent casting chambers. Centrally of the outer wall of each of the charging chambers a charging opening 11 adapted to be closed by a sliding charging door 12 formed of fire-brick, is provided.

Centrally of the outer wall of each of the series of the casting chambers an opening 13 is provided adapted to be closed by a sliding fire-brick door 14. Within the upper open portion of the series of casting chambers, a fuel supply nozzle (not shown) is provided through which atomized crude oil or some such fuel mixture may be projected into the casting chambers. Counterweights (not shown) may be individually applied to each of the doors of the several charging and casting chambers so that the same may be readily lifted and lowered when the furnace is in operation. In addition to the fuel supply charged directly into the upper portion of the casting chambers above the metal reservoirs, provision is made for the heating of each of said series of furnaces by means of nozzles (not shown) within one end of the arched chambers 6 and 7 heretofore described. An opening 16 is provided at the end of the chamber 7 to permit egress of excess hot gases at that end of the furnace, and this lower opening also constitutes a safety overflow in the event of a leak in the metal reservoirs.

On the discharge or casting side of the furnace, a tap hole 15 and spout 16 is provided adjacent the central lower portion of each of the metal reservoirs. Along each lateral side of the furnace tanks or troughs 17, 18, adapted to be filled with water are provided into which hot skimings from the top surface of the molten metal may be dropped as the occasion arises. The depositing of the skimming in the troughs separates the aluminum from the dirt and the aluminum may be again used as part of a charge for the furnace.

At each end of the charging side of the series of furnace units adjacent the top arch an opening 21 is provided, over which a door 22 lined with fire-brick is hung, and through which the furnace gases carrying light dust and dirt and the burning particles of grease and oil, which may be mingled therewith, partially escape. These doors also serve as safety or "explosion" doors and prevent undue pressure within the furnace.

It will be noted that above the surface of the molten mass of metal the furnace carries a heavy bank of hot gases which are sufficient in quantity to completely fill the space referred to and that such gases are at a slightly higher pressure than the outside atmosphere and constantly seek a passageway through the end openings on the charging side of the furnace heretofore described.

Thus when metal stock is charged through any of the several openings into the charging chambers, but little air enters at such points because of the higher pressure of the gases within the furnace which seek egress at such time. Each of the end and internal walls of both the charging and casting chambers is provided with a flue (see Figure 3) respectively through which the gases of combustion may pass in part, thus maintaining the temperature of the furnace walls at the desired point. The flues on the casting side are ordinarily left open but the flues on the charging side are kept closed by covers inasmuch as the lower heating chamber 8 is only intended for emergency use, at times when the furnace charge might freeze and require a high degree of heat to remelt.

The means for agitating the molten mass of metal on the charging side of the furnace will now be described and while a particular embodiment of such apparatus is illustrated, it is to be understood that other mechanism for accomplishing the same result may be employed instead of that illustrated. Within each of the charging chambers a grid or stirring member is provided which is of an outline similar to that of the furnace chamber and of slightly smaller size than said chamber. Said member comprises a heavy central portion or boss, 32, and a series of radial arms 33 gradually decreasing in thickness toward their free ends and joined at such ends by a rim 34 of metal corresponding in outline to the outline of the furnace chamber and spaced from the walls thereof. Between the radiating arms spaces are provided through which the molten metal may freely pass as the grid is plunged downwardly into the molten metal and withdrawn therefrom by the mechanism presently to be described.

Centrally of the grid a beveled socket 36 is provided through which the lower end of the operating stem 37 of the agitating device may be received. The lower end of the stirring rod or operating member is provided with notches 38 to receive projections 39 upon a series of shoes 41 which have beveled sides 42 terminating in outwardly extending flanges 43. In order to engage the grids with the operating rods, the lower ends of said rods are inserted through the central apertures of said grids and the shoes or tapered plates are engaged with said rods and the grid lowered on the outer beveled surfaces of said plates. The beveled surfaces on the grid aperture and on the outer side of the respective plates coact to insure a firm engagement of the grid with the rod. The rod may be supplied in two sections which are joined to each other in a spliced joint 44 providing a pair of shoulders and overlapping extensions of half the rod size which are firmly bolted together. A boot 46 packed with fire clay and strapped about each rod above the grid prevents the burning out of the rod as it is plunged into the molten mass of metal.

Each of the rods is engaged through an aperture 45 in the roof of the charging side of the furnace so as to reciprocate therein with a minimum loss of heating gases therethrough. Above the furnace said rods are each adapted to reciprocate between two pairs of rollers 46, 49, firmly mounted upon a supporting frame 48 so as to maintain said rod in constant alignment with the aperture through said furnace roof. These rollers are preferably flanged rollers engaging in pairs on opposite sides of the square operating rod and suitable lubricating device for

said rollers may be provided. The rod is set angularly to provide for easy removal of oxide and refuse or skimming.

The upper end of the rod is provided with an aperture 51 for attaching a lifting cable 52. Adjacent the upper end of the rod an extension arm 53 is provided to which a grid depressing cable 54 is secured. The respective cables are passed about pulleys 55, 56, secured to fixed supports above the rod and adjacent the roof of the furnace respectively and thence passed in opposite directions to a pair of sheave wheels 57, 58, mounted upon a shaft preferably located on a platform 61 above the level of the furnace roof. The shaft carrying the respective pairs of sheave wheels is oscillated by suitable mechanism shown in this instance as an electric motor 62 coupled with a suitable reducing gear 63 to a crank arm 64 which is joined by a connecting rod 65 with a similar crank arm 66 on the oscillating shaft. The proportions of the parts are such that the shaft will be rotated through approximately 90° with each complete rotation of the first mentioned crank arm.

Each of the pairs of sheave wheels heretofore described is provided with a clutch member 67 on the oscillating shaft. The shifting bars (not shown) for the clutches are extended from the elevated platform to a position convenient to the furnace floor so that the operation of the clutches may be readily controlled adjacent the charging side of the furnace. In addition to the sheave wheels heretofore described and the fixed pulleys, it is desirable to provide counterweights for the grids and supporting arms and spring take-up means to prevent excessive strains upon the mechanism. Accordingly, a spring 71 is inserted in the line of the grid depressing cable and counterweight 72 is carried at the end of the grid elevating cable. The counterweight is adapted to bear against a stirrup bar 73 supported on a pair of springs 74 which are secured to a fixed support 76 above the top range of motion of the counterweight so as to hold said bar in the path of movement of the counterweight when the grid is drawn from the metal bath. The counterweights are guided upon a pair of bars 77 supported at each end in the frame of the operating mechanism and springs 78 on said bars serve as buffers. An adjusting pulley 81 is provided in the line of grid elevating cable preferably supported on a pair of arms 82 pivoted to the frame at a point adjacent the sheaves and supporting said pulley rearwardly in alignment therewith. Each of said pairs of frames is provided with a stationary nut 83 through which the upper end of a screw threaded rod 84 is adapted to engage. A handwheel is attached at the lower end of said rod whereby said pulley may be adjusted upwardly or downwardly to the necessary extent to lift the grid to any point desired with respect to the liquid mass in the furnace chamber. Thus by turning the screw in one direction the grid may be fully withdrawn from the bath of liquid metal and held at a point above the charging opening of its furnace.

When adjusted in the opposite direction the grid may be forced to a considerable depth within the molten mass of metal as it reaches its lowest limit of motion in the charging side of the furnace. The spring provided in the grid depressing cable is put under tension as the grid is elevated and is relieved of the larger part of such tension when the grid is lowered to its usual operative position. It also serves as a resilient safety device

when the grid strikes an obstruction in its descent. Thus complete control of the agitating mechanism of the furnace is provided both as to the starting and stopping of the agitation and the position of the agitator with respect to the molten mass of metal may be readily adjusted. Through a suitable rheostat the motor speed of the operating device may be controlled and thus the rate of agitation may be regulated.

In the form of construction illustrated in Figures 7 and 8, two puddling or agitating chambers 101, 102, are provided at a central position. Melting chambers 103 and 104 are provided respectively on the opposite sides of the agitating chamber 101, and melting chambers 105 and 106 are provided respectively on the opposite sides of the agitating chamber 102. Each of the melting chambers communicates with the adjacent agitating chamber through an opening 107, preferably adjacent the floor of said chamber. Each of the said melting chambers may be used, either, for introducing metal in the form of large sections, such as castings or plates or ingots, and having the same flow after melting into the agitating chamber for the deoxidizing and refining action, or such melting chambers, or either of them, selectively, may be used to receive the treated mass of metal from the agitating chamber and temper the same to the proper degree of heat for fabricating purposes. The flow of the metal from either side may be controlled by means of plugs inserted in the communicating openings and by the amount of material introduced into or withdrawn from the respective chambers and the chamber on either side of the puddling chamber may be used for the melting or casting charge of metal as may be preferred. The construction and action of the agitating mechanism is substantially the same as that previously described in connection with the device illustrated in Figures 1, 2 and 3. Each of the chambers adjacent the puddling chamber is provided with heating means (not shown) through which oil or other heating medium is introduced in the furnace to maintain the metal at the desired degree of temperature. The furnace is shown as having an arch construction similar to that shown in Figures 1 to 3, but obviously in either of the constructions the furnace may be built directly on the ground without heating or safety means beneath the furnace floor.

The agitating chambers 101 and 102 are open at their upper portions, the dividing wall 108 extending only to a point a short distance above the metal bath and approximately to a level of the base of the charging doors. The charging doors 107, 109, are of a size to permit the withdrawal of the grid therethrough at either side. Each of the melting and charging chambers is provided with a draw-off hole 109 and a spout 111.

Each of the melting chambers is provided with a door 112 in the side wall and a door 113 in the end wall. The door in the end wall permits the plugging by means of a clay ball, or the like, of the opening from said chamber into the puddling chamber. In the form of construction shown in Figure 9 of the drawings, two puddling chambers, 114, 115, are shown centrally of one side of the furnace, and a melting chamber is shown in the space at the end of the furnace adjacent each of the respective puddling chambers. These melting chambers, 116, 117, communicate by means of an opening adjacent the bottom thereof with the puddling chamber, such opening 118 being adapted to be plugged from the end of the chamber

through a door in the end wall of such melting chamber. These end doors 119 may be used as the charging doors or metal charged into the melting chamber may be placed therein through the side doors 121. In addition to the melting chambers described, the furnace is provided with elongated melting chambers on the opposite side of the furnace. These chambers 122, 123, communicate with the agitating chambers through openings 124 adjacent the bottom of said chambers, and also communicate with the end melting chambers 116, 117, through suitable openings in the bottom thereof. The walls 125, 126, between the end and rearward melting chambers may extend only to a slight distance above the metal bath, so that the heat within the several melting chambers may extend continuously around the furnace. Suitable oil or gas burners may be employed to maintain the heat in the melting and casting chambers at any desired temperature. Suitable tapping holes and spouts may be provided adjacent the several chambers.

The apparatus disclosed in Figures 7 and 8 is particularly suited for carrying on a continuous process of production of material suitable for commercial fabrication from readily oxidizable metals such as aluminum with a high degree of speed and great economy of manufacture, and permits of the addition of finely divided material directly into the puddling chamber and the addition of heavy scrap through one of the auxiliary chambers in connection with such puddling chamber. Thus all classes of commercial secondary sources of raw material for aluminum manufacture may be drawn upon and the supply of metal for the puddling and casting chambers may be kept up to requirement by drawing upon any stock which may be available at the particular time of use.

In each of the instances illustrated substantially the entire quantity of metal in the puddling chamber is acted upon by the grid which strikes the metal with a heavy impact and forces subdivided portions thereof through the apertures in the grid and carries loose particles through the interacting streams of molten metal and into the portions of the molten bath below the upper surface thereof so that the collected metal in the bottom of the puddling chamber may be brought into direct contact to freshly exposed particles of aluminum and envelope and incorporate the same directly into such body through coalescence.

The working of the metal in this way has a readily recognizable effect in improving the tenacity and strength of the fabricated material and the recovery of metal has been carried out commercially with as high or a higher degree of recovery than ordinary fire assay of samples will show because of the greater losses caused in the course of such assay through oxidation.

It will be noted that oxidation is prevented through the fact that the grease and oil and other combustible material carried with the charge of fine particles placed within the agitating chamber are gasified under conditions wherein complete combustion is not effected and therefore reducing gases such as carbon-dioxide, carbon monoxide, hydrogen, and other gases are held as a blanket at slightly greater than atmospheric pressure above the surface of the bath of molten metal undergoing treatment. The agitating member rises above the surface of the bath for periods of time adequate for the cooling of the grid to such degree that its working efficiency is not impaired through substantially continuous use.

With the use of materials such as cast iron for the puddling apparatus, it is necessary to have a period of cooling substantially equal to the period of contact with the hot metal in order to prevent the undue heating of the puddling apparatus and the alloying of the same with the bath of molten aluminum, or other metal.

In the form of construction illustrated in Figure 10, a grid 131 of somewhat modified form is shown wherein the arms 132 are provided at their ends with sections 133 of an outer flange which is thus not continuous, in order that fracture of the grid will not occur through undue expansion of the narrow marginal members.

It has heretofore been proposed to puddle type metal and like low melting point metals by means of mechanism constantly immersed within the molten bath and this is commercially practicable because of the low temperatures involved. Where, however, high temperatures from 1200° to 1600° F. are present in the furnace it will be readily understood that the ordinary mechanism for agitating the molten bath could not be employed as it would not remain in operative condition for an adequate period to warrant its installation. Furthermore, the constant contact of an iron vessel with a bath of molten aluminum or of iron stirring devices with such bath tends to alloy said iron with the aluminum introducing a factor which interferes with the quality of the finished product, as iron in excess is very harmful to the physical characteristics of the aluminum for fabricating purposes.

The present furnace, therefore, presents a structure wherein a non-metallic chamber is provided for the heating of readily oxidizable metals, and metals which readily form ferrous alloys, and at the same time is of adequate strength and equipped with safety chambers beneath the same so that no harmful or dangerous elements are involved in the commercial utilization of the same.

While the ducts connecting the chambers at either side of the puddling chamber with the puddling chamber have been shown adjacent the base of each of the chambers, and the floors of said chambers have been substantially on an equal level, it is to be understood that under certain circumstances it may be found desirable to have a supply chamber for the molten mass at a higher level than that of the puddling chamber and the casting chamber for the device at a lower level. Such variations are to be understood as coming within the scope of any claims of sufficient breadth not to specifically exclude the same.

The product resulting from the working and sub-dividing of the molten metal mass, particularly of aluminum and its alloys has been found to be of a tenacity superior to that of any product which might be formed by other methods from the same identical class of material. Thus, if secondary material such as borings, turnings, filings, skimmings, and the like, are melted in an ordinary melting pot under the present practice, a large portion of such product will escape in the form of oxides and gases and the actual aluminum recovered will be but a small percentage of that found to be present in the raw material. With the applicant's apparatus and method of treatment, however, it has been found that the recovery of aluminum in the final product can be made equal to that shown to be in the raw material even when secondary material, carrying as low as fifteen (15) per cent of aluminum is employed.

Furthermore, through the use of this appa-

ratus and method, metal in fabricated form can be produced in a single operation, from very low grade raw material. The metal, whether cast into finished articles or into ingots, after the thorough puddling it received in the apparatus described, shows a great tenacity and a fine quality of grain such as can be produced only under most perfect conditions with substantial laboratory facilities as compared with high speed commercial production.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and steps herein disclosed, provided the means and steps stated by any of the following claims or the equivalent of such stated means and steps be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In a method of treating aluminum, the steps which consist of maintaining two separate masses of molten aluminum in communication with one another in a non-oxidizing atmosphere, agitating one of said masses, supplying material thereto from the other of said masses, withdrawing molten metal from the mass undergoing agitation into a separate chamber, controlling the temperature thereof to a degree requisite for fabricating purposes, and withdrawing molten metal from time to time for fabricating purposes.

2. In a method of treating aluminum, the steps which consist of maintaining two separate masses of molten aluminum in communication with one another in a non-oxidizing atmosphere, agitating one of said masses, supplying remelted material directly to said mass undergoing agitation and supplying molten aluminum to the mass undergoing agitation from the other of said masses, with-

drawing molten metal from the mass undergoing agitation into a separate chamber, controlling the temperature thereof to a degree requisite for fabricating purposes, and withdrawing molten metal from time to time for fabricating purposes.

3. In a method of reworking aluminum, the steps which consist of maintaining three separate masses of molten aluminum in communication with one another in a non-oxidizing atmosphere, agitating one of said masses, adding finely divided aluminum to the mass undergoing agitation, adding stock substantially free of oxides to one of the other masses of metal, and withdrawing molten metal from the third mass of metal for fabricating purposes.

4. In a method of reworking aluminum, the steps which consist of maintaining three separate masses of molten aluminum in communication with one another in a non-oxidizing atmosphere, agitating one of said masses, adding finely divided aluminum to the mass undergoing agitation, adding heavy aluminum stock substantially free of oxides to the second of said other masses of metal, and withdrawing molten metal from the third of said masses of metal for fabricating purposes.

5. In a method of treating aluminum, the steps which consist of maintaining an intermediate mass of molten aluminum in communication with an adjacent mass of molten aluminum at each side thereof through narrow neck portions adjacent their base, agitating said intermediate mass, supplying material through one of the other masses, and withdrawing material for fabricating purposes from the other of said adjacent masses.

JOHN SCHMELLER, SR.

CERTIFICATE OF CORRECTION.

Patent No. 2,072,650.

March 2, 1937.

JOHN SCHMELLER, SR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 35, claim 2, for "remelted" read unmelted; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of April, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

ratus and method, metal in fabricated form can be produced in a single operation, from very low grade raw material. The metal, whether cast into finished articles or into ingots, after the thorough puddling it received in the apparatus described, shows a great tenacity and a fine quality of grain such as can be produced only under most perfect conditions with substantial laboratory facilities as compared with high speed commercial production.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and steps herein disclosed, provided the means and steps stated by any of the following claims or the equivalent of such stated means and steps be employed.

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2. In a method of treating aluminum, the steps which consist of maintaining two separate masses of molten aluminum in communication with one another in a non-oxidizing atmosphere, agitating one of said masses, supplying remelted material directly to said mass undergoing agitation and supplying molten aluminum to the mass undergoing agitation from the other of said masses, with-

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Signed and sealed this 20th day of April, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.