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APPARATUS FOR SEPARATING METALS

Filed June 7, 1961

Fig. 1.

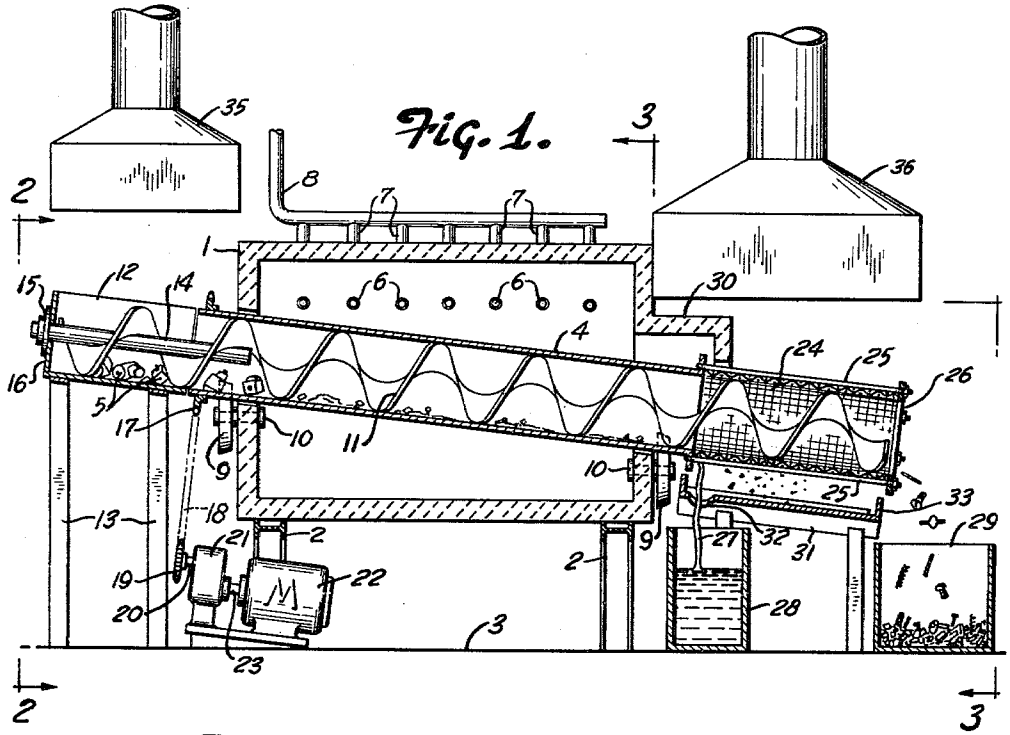


Fig. 2.

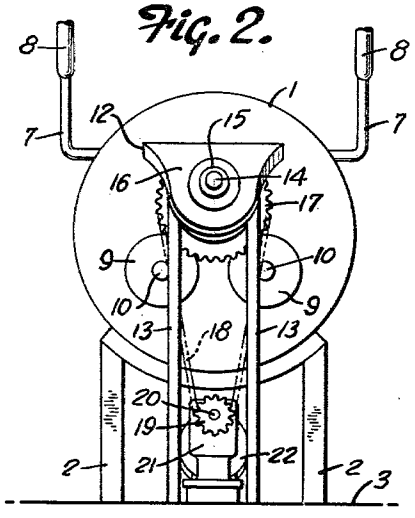
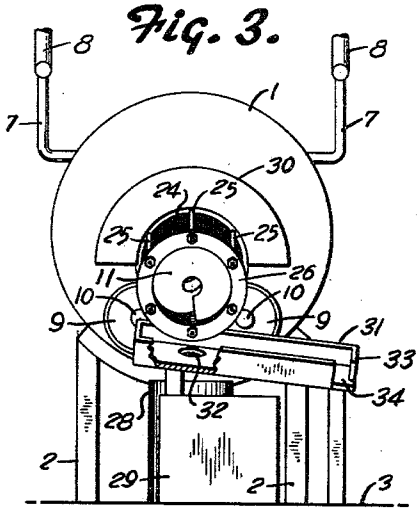


Fig. 3.



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APPARATUS FOR SEPARATING METALS

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8 Claims. (Cl. 266—37)

This invention relates to an apparatus for separating metals and more particularly to an apparatus separating two different alloys from scrap metal.

There is a large quantity of scrap metal which consists of two or more different alloys. Generally this type of scrap has very little value unless the metals are separated. For example, zinc or aluminum alloy die castings generally contain small elements of iron or steel such as bushings, pins, screws, bolts, jets, etc., which cannot be conveniently separated from the die cast alloy except through the use of expensive hand labor. These die cast alloys containing the small iron or steel parts have very little value for scrap purposes and processes have been devised in the past in an attempt to economically separate the die cast alloys from the ferrous metals.

The present invention is directed to an apparatus for separating two alloys from scrap metal in a continuous process. In general the apparatus comprises an inclined tube or retort which is mounted for rotation within a furnace. A spiral flight or auger blade is secured within the retort and extends outwardly beyond both ends of the tube. A hopper is associated with the upper end of the tube and is positioned around the projecting end of the spiral flight. The scrap metal to be separated is introduced into the hopper and is carried downwardly through the rotating tube by means of the spiral flight.

The lower end of the spiral flight extends outwardly beyond the rotating tube and a screen or other member of open construction is secured to the lower end of the flight and rotates therewith.

As the scrap metal moves downwardly through the rotating tube within the furnace, the lower melting point alloy is melted and flows downwardly within the tube while the higher melting point alloy will not be melted. As the molten alloy reaches the lower end of the tube it will flow downwardly through the screen into a container for collection, while the unmelted higher melting point alloy particles will be conveyed through the screen by the spiral flight and are collected in a second container.

In addition to the separation of the molten low melting point alloy from the unmelted materials, an additional provision is made for the separation of the fines or dust. To accomplish this separation, the molten metal flowing from the lower end of the tube passes through an opening in a generally flat plate before it is collected in the container. The fine particles or dust also pass through the screen on the end of the flight, but due to the centrifugal motion of the rotating tube, the fine particles are carried beyond the vertical centerline of the tube and therefore are deposited on the plate beneath the screen rather than passing through the opening in the plate. Thus, in addition to the separation of the molten material and the unmelted particles, the fines and dust are collected on the plate.

With the process of the invention, a clean metal separation results with little skimming required and the remaining pieces of the higher melting point alloy are relatively free of oxides and scum. Due to the tumbling action provided by the spiral flight and the rotating tube, the softer metals and oxides are knocked off of the harder materials so that a mechanical separation is also provided by the apparatus.

With the use of the rotating tube within the furnace, a very close temperature control can be obtained and due to the improved temperature control, a very little quantity of metal oxides is formed in the furnace so that there is no appreciable loss of the metals due to oxide formation.

The speed of rotation of the spiral flight also serves as a time control and the material can be kept in the melting zone for the desired period of time.

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

FIGURE 1 is a vertical section taken through the apparatus of the invention;

FIG. 2 is an end view of the inlet portion of the apparatus; and

FIG. 3 is an end view of the discharge portion of the apparatus.

The drawings illustrate an apparatus for separating scrap metal into its alloy components and comprises a furnace 1 which is mounted on supports 2 which rest on the foundation 3. An inclined tube 4 is mounted for rotation within aligned openings in the end walls of the furnace 1 and the scrap metal pieces 5 are introduced into the upper end of the tube and pass downwardly therein to the lower end.

Heat is applied to the scrap metal passing within the tube by a plurality of gas jets 6 which are located above the tube 4. Each of the gas jets 6 is connected to an inlet tube 7 which extends through the wall of the furnace and each tube 7 is connected to a manifold 8 which supplies gas to the jets.

The tube 4 is rotatably supported on a series of rollers 9 which are journaled on shafts 10 extending outwardly from the end walls of the furnace. The tube 4 rests on the respective pairs of rollers and is supported for rotation thereon.

A spiral flight 11 is welded to the inner surface of the tube 4 and projects outwardly beyond both ends of the tube. A hopper 12 is associated with the upper end of the tube 4 and is positioned around the projecting end of the spiral flight 11. The scrap material 5 is adapted to be introduced into the hopper either manually or by a suitable conveying mechanism.

The hopper 12 is fixed and is supported on a series of legs 13 which are mounted on the foundation 3 and the spiral flight 11 rotates therein to convey the scrap downwardly to the tube 4. The end edge of the hopper 12 abuts the opposed edge of the tube 4, and a shaft 14 is welded centrally to the flight 11 and extends outwardly within the hopper and serves to support the portion of the spiral flight 11 disposed within the hopper. The outer end of the shaft 14 is journaled within a bearing 15 formed in the end wall 16 of the hopper.

To rotate the tube 4, a sprocket 17 is secured to the upper end of the tube adjacent the end of the furnace 1. The sprocket 17 is connected by chain 18 to a drive sprocket 19 mounted on the output shaft 20 of a speed reducing unit 21. Power is supplied by a motor 22 and the output shaft 23 of the motor is connected to the speed reducing unit 21. With this construction, the rotation of the motor drive shaft 23 serves to slowly rotate the tube 4 within the furnace.

The lower end of the spiral flight 11 extends outwardly beyond the end of the tube 4 and a cylindrical screen 24 is welded to the outer edge of the spiral flight. The screen is also supported by a series of longitudinal rods 25 which are secured within suitable openings in the flange 26 on tube 4. The outer ends of the rods 25 are connected together by a ring 26.

As the scrap metals 5 move downwardly within the rotating tube 4, the lower melting point alloy, such as a zinc or aluminum base alloy, is melted while the higher melting point alloy, such as steel or cast iron, will not be melted. As the molten metal 27 flows from the lower end of the tube 4, it passes through the openings in the screen 24 and is collected within a container 28. However, the unmelted pieces of the higher melting point alloy will be conveyed through the screen by the spiral flight 11 and will be discharged from the end of the flight and collected in a second container 29.

To prevent the molten alloy from solidifying or freezing on the screen as the same flows therethrough, the furnace is provided with an extension 30 which extends outwardly and downwardly over the exposed end of the tube 4 and the adjacent portion of the screen 24. The extension or hood 30 functions to retain the heat in the covered area and thereby prevents the molten metal from freezing on the screen 24.

An additional separation of materials is provided by a plate 31 which is located beneath the screen 24. The plate 31 is provided with an opening 32 which is in vertical alignment with the centerline of the spiral flight 11. The molten alloy 27 being discharged from the lower end of the tube 4 will flow downwardly through the opening 32 into the container 28. However, the light dust and other particles which are small enough to pass through the screen 24 will be carried upwardly by the centrifugal action of the rotating screen to a point beyond the vertical centerline of the tube so that the dust and other small materials will pass through the screen and will be deposited on the plate 31. The plate is provided with a peripheral rim 33 and slopes downwardly to a collection corner 34 where the dust and other small particles can be collected into a suitable container.

Exhaust hoods 35 and 36 are located over the projecting upper and lower ends of the flight 11 and serve to vent any gases or oxides produced by the melting action within the tube 4.

The tumbling action provided by the rotating tube and the spiral flight tends to separate the low melting point materials from the higher melting point materials by a mechanical action as well as the melting action. Further, the tumbling action results in both the molten metal and the unmelted scrap particles being in a clean state, being free of oxides and scum.

As the scrap is not directly heated but is contained within the rotating tube, a more accurate control of the temperature can be obtained and this will result in a minimum oxide formation and loss of the metals in the form of the oxides.

The process provides for the separation of three distinct phases, the molten low melting point alloy, the higher melting point pieces and the fines or dust. The separation of the three materials is accomplished in a continuous operation and this results in a substantial cost savings.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. An apparatus for separating materials, comprising an inclined tube to convey a material composed of a higher melting point substance and a lower melting point substance with said material adapted to be introduced into the higher end of the tube and discharged from the lower end thereof, means for rotating the tube about the axis thereof, means disposed within the tube for providing a tumbling action for the material passing therethrough, heating means for heating the material disposed within the tube to heat the material to a temperature above the melting point of the lower melting point substance to melt the same and below the melting point of the higher melting point substance, and a foraminous member secured to and extending outwardly from the lower end of the tube with the molten lower melting point substance being discharged from the lower end of the tube and passing downwardly through said foraminous member to a collection reservoir and the unmelted higher melting point substance passing over said foraminous member and being collected in a second collection reservoir.

2. An apparatus for separating materials, comprising an inclined tube disposed to convey a material composed of a higher melting point substance and a lower melting point substance with said material being introduced into the higher end of the tube and being discharged from the lower end thereof, means for rotating the tube about the axis thereof, means disposed within the tube for providing a tumbling action for the material passing through the tube, heating means for heating the material disposed within the tube to a temperature above the melting point of the lower melting point substance to melt the same and below the melting point of the higher melting point substance, a screen extending outwardly from the lower end of the tube, first collection means disposed beneath the screen in vertical alignment with the centerline of the tube for collecting the molten lower melting point substance as the same flows from the lower end of the tube and passes through the screen, second collection means disposed beneath the screen and located circumferentially in the direction of rotation of the tube from the vertical centerline thereof to collect the fine particles discharged from the tube and passing through the screen, and third collection means located at the end of the screen for collecting the higher melting point substance which passes over the screen.

3. An apparatus for separating alloys, comprising a furnace, an inclined tube disposed in aligned openings in the walls of the furnace and adapted to contain metal scrap composed of a higher melting point alloy and a lower melting point alloy with said metal scrap being introduced into the higher end of the tube and being discharged from the lower end thereof, means for rotating the tube about the axis thereof, heating means disposed within the furnace for heating the metal scrap within the tube to a temperature above the melting point of the lower melting point alloy to melt the same and below the melting point of the higher melting point alloy, a spiral flight secured to the inner surface of the tube and rotatable therewith with the lower end of the spiral flight projecting outwardly of the lower end of the tube, a hopper associated with the end of the higher spiral flight and disposed to deliver metal scrap to said spiral flight, and a generally cylindrical screen extending outwardly from the lower end of the tube and secured to the portion of the spiral flight projecting beyond the lower end of the tube with the molten lower melting point alloy adapted to be discharged from the lower end of the tube and pass through the screen to a collection container and the unmelted higher melting point alloy scrap passing over the screen and being collected in a separate collection container.

4. An apparatus for separating alloys, comprising a furnace, an inclined tube disposed in aligned openings in the walls of the furnace with the ends of the tube projecting beyond the walls of the furnace, said tube adapted to contain metal scrap composed of a higher melting point alloy and a lower melting point alloy with said metal scrap being introduced into the higher end of the tube and being discharged from the lower end thereof, means for supporting the tube for rotation about the axis thereof, drive means operably connected to an end of the tube for rotating said tube, gas heating means disposed within the furnace above said tube for heating the metal scrap within the tube to a temperature above the melting point of the lower melting point alloy to melt the same

and below the melting point of the higher melting point alloy, a spiral flight secured to the inner surface of the tube and rotatable therewith with the ends of the spiral flight projecting outwardly of the ends of the tube, a hopper associated with the end of the spiral flight projecting from the higher end of the tube and disposed to deliver metal scrap to said spiral flight, and a generally cylindrical screen extending outwardly from the lower end of the tube and secured to the portion of the spiral flight projecting beyond the lower end of the tube with the molten lower melting point alloy adapted to be discharged from the lower end of the tube and pass through the screen to a collection container and the unmelted higher melting point alloy scrap passing over the screen and being collected in a separate collection container.

5. An apparatus for separating alloys, comprising a furnace, an inclined tube disposed in aligned openings in the walls of the furnace and adapted to contain metal scrap composed of a higher melting point alloy and a lower melting point alloy with said metal scrap being introduced into the higher end of the tube and being discharged from the lower end thereof, means for rotating the tube about the axis thereof, heating means disposed within the furnace for heating the metal scrap within the tube to a temperature above the melting point of the lower melting point alloy to melt the same and below the melting point of the higher melting point alloy, a spiral flight secured to the inner surface of the tube and rotatable therewith with the ends of the spiral flight projecting outwardly of the ends of the tube, a hopper disposed in axial alignment with the higher end of said tube and surrounding the end of the spiral flight projecting from said higher end of the tube, said hopper having an open top to receive the metal scrap and being fixed against rotation whereby said spiral flight rotates within the hopper to move the scrap downwardly into said tube, and a screen extending outwardly from the lower end of the tube and secured to the portion of the spiral flight projecting beyond the lower end of the tube with the molten lower melting point alloy adapted to be discharged from the lower end of the tube and pass through the screen to a collection container and the unmelted higher melting point alloy scrap passing over the screen and being collected in a separate collection container.

6. An apparatus for separating alloys, comprising a furnace, an inclined tube disposed in aligned openings in the walls of the furnace with the ends of the tube projecting outwardly beyond the walls of the furnace, said tube adapted to contain metal scrap composed of a higher melting point alloy and a lower melting point alloy with said metal scrap being introduced into the higher end of the tube and being discharged from the lower end thereof, means for rotating the tube about the axis thereof, heating means disposed within the furnace for heating the metal scrap within the tube to a temperature above the melting point of the lower melting point alloy to melt the same and below the melting point of the higher melting point alloy, a spiral flight secured to the inner surface of the tube and rotatable therewith with the lower end of the spiral flight projecting outwardly of the lower end of the tube, a hopper associated with the higher end of the tube and disposed to deliver metal scrap to said spiral flight, a generally cylindrical screen extending outwardly from the lower end of the tube and secured to the portion of the spiral flight projecting beyond the lower end of the tube with the molten lower melting point alloy adapted to be discharged from the lower end of the tube and pass through the screen to a collection container and the unmelted higher melting point alloy scrap passing over the screen and being collected in a separate collection container, and a hood disposed over the lower end of the tube and over the adjacent end of the cylindrical screen to insulate the same and prevent the molten alloy from freezing on said screen.

7. An apparatus for separating alloys, comprising a furnace, an inclined tube disposed in aligned openings in the walls of the furnace and adapted to contain metal scrap composed of a higher melting point alloy and a lower melting point alloy with said metal scrap being introduced into the higher end of the tube and being discharged from the lower end thereof, means for rotating the tube about the axis thereof, heating means disposed within the furnace for heating the metal scrap within the tube to a temperature above the melting point of the lower melting point alloy to melt the same and below the melting point of the higher melting point alloy, a spiral flight secured to the inner surface of the tube and rotatable therewith, a hopper associated with the higher end of the tube and disposed to deliver metal scrap to said spiral flight, a generally cylindrical member having a perforated side wall and secured to the lower end of said tube and projecting beyond the lower end of the tube, a first container located beneath the lower end of the tube in substantially vertical alignment with the vertical centerline of the tube and disposed to collect the molten lower melting point alloy as the same is discharged from the lower end of the tube and passes through said member, a second container located beneath said member and disposed circumferentially in the direction of rotation of the tube from the vertical centerline of the tube, said second container adapted to collect the fine particles discharged from the lower end of the tube and passing through said member, and means located at the lower end of the cylindrical member for receiving the higher melting point alloy scrap passing over said member.

8. The structure of claim 7, in which said second container is located directly beneath said member and is provided with an opening disposed in substantially vertical alignment with the vertical centerline of the tube and said first container is located below said second container and in vertical alignment with said opening.

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