Jan. 6, 1970 H. VIERECK 3,487,925

SCREENING HOT SOLIDS

Filed July 7, 1965 3 Sheets-Sheet 1

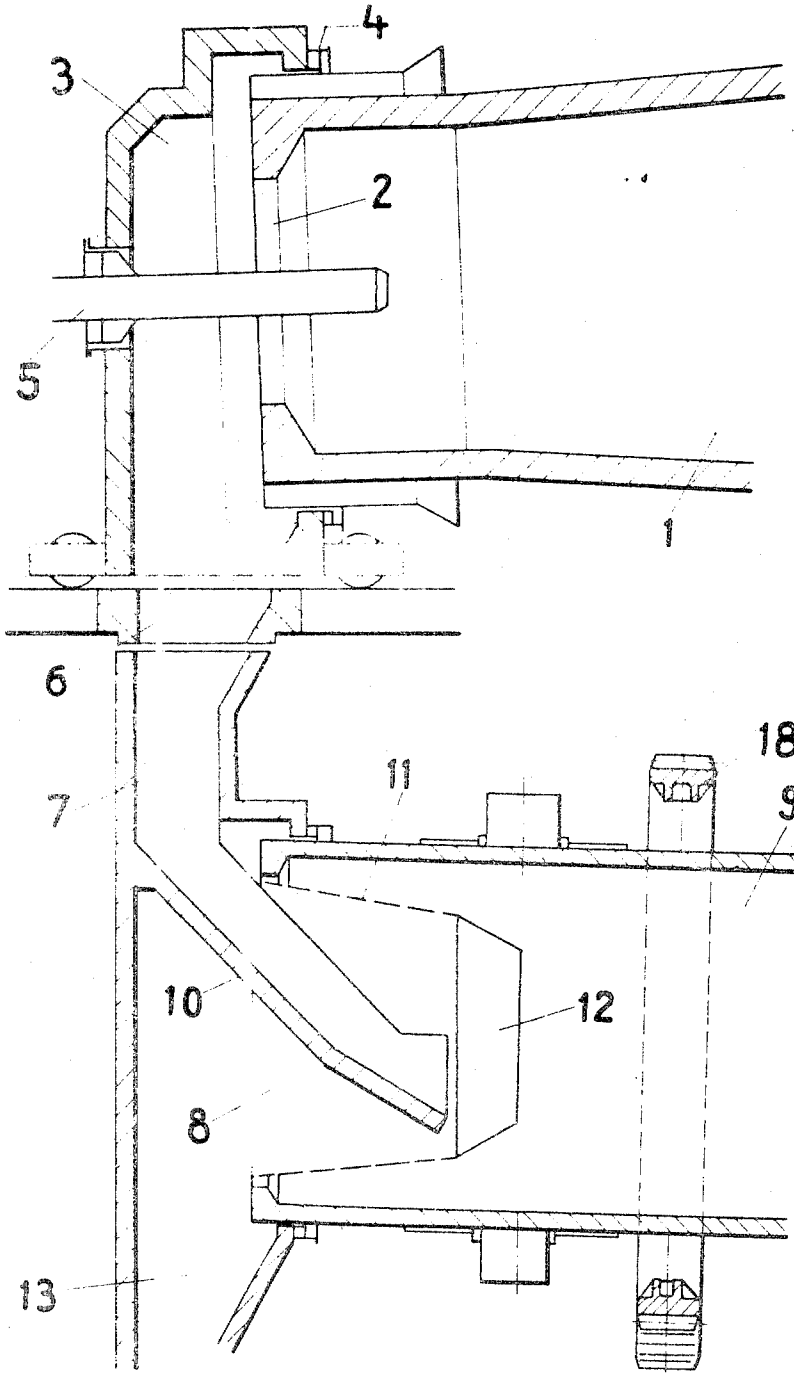

Fig. 1

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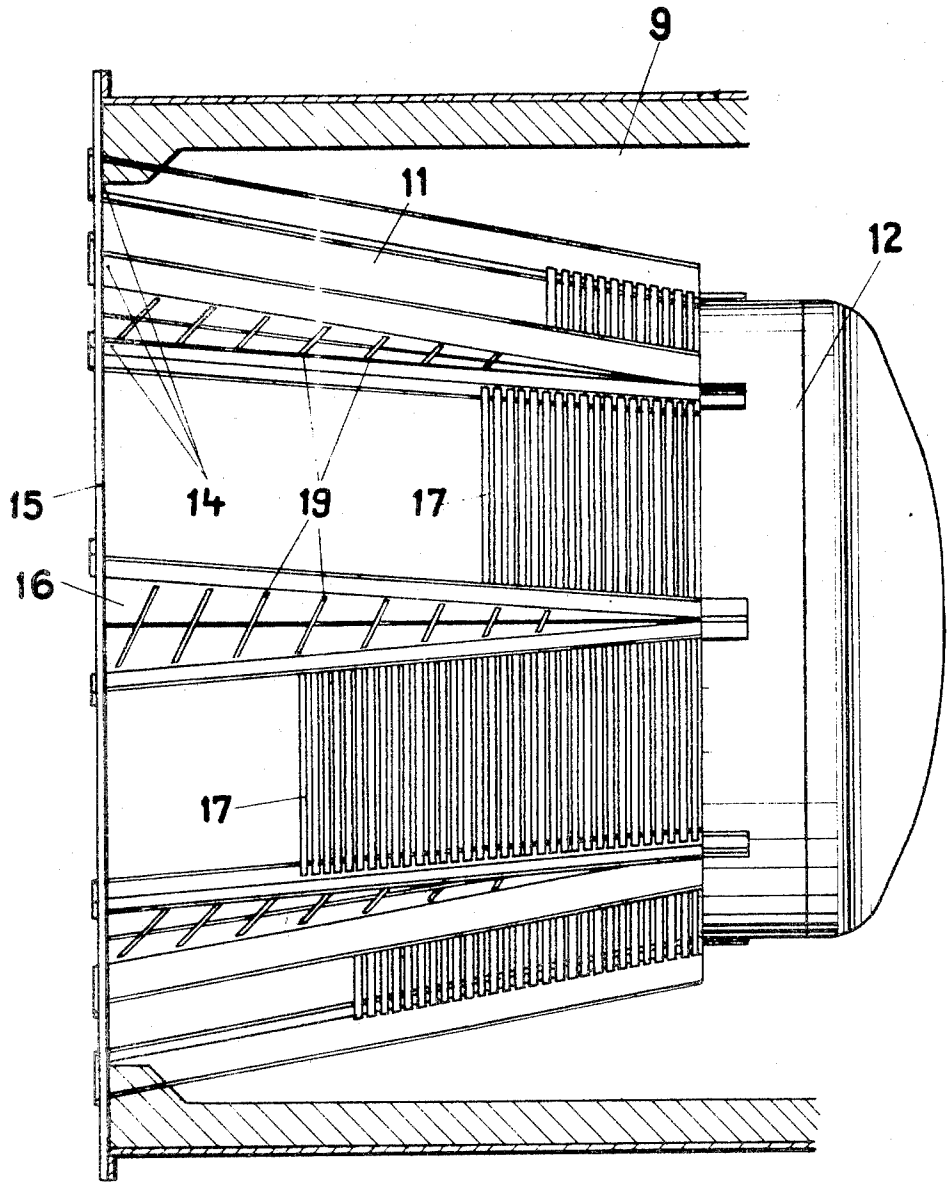

Fig. 2

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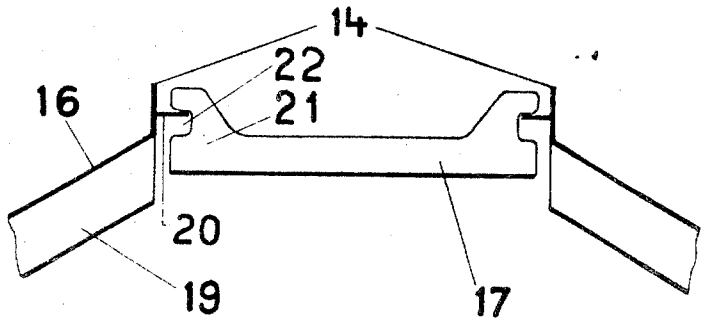

Fig. 3

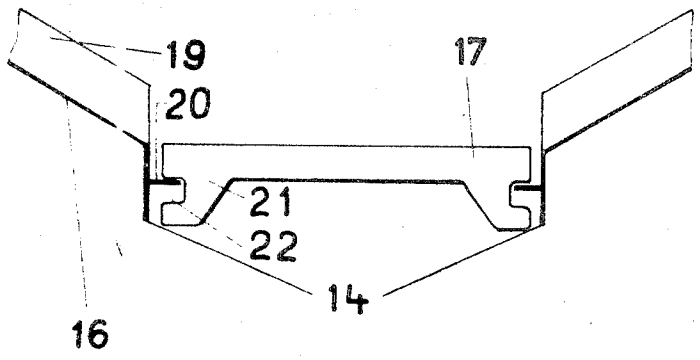

Fig. 4

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SCREENING HOT SOLIDS

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Int. Cl. B07b 1/24; B08b 1/00
U.S. Cl. 209—238 1 Claim

ABSTRACT OF THE DISCLOSURE

Hot solids coming from a kiln are introduced through a frusto-conical screen into a rotary cooler. The screen is inserted into the inlet end of the cooler and rotates therewith. The fines drop into the cooler while the coarses fall off the screen and drop out the inlet end of the cooler.

This invention relates to apparatus for screening hot solid particle size mixtures.

A number of chemical and metallurgical processes carried out at elevated temperatures in rotary kilns involve the problem of screening the hot solids discharged from the kiln into different particle size fraction and material constituents without previous cooling. This problem arises particularly in the direct reduction of iron ore pellets, if the reduced pellets are to be charged to a succeeding melting furnace at an elevated temperature for improved heat economy.

It has already been suggested to provide perforated sheet metal baffles in a rotary kiln near the discharge end thereof for raising the solid mixture from the feeding bed owing to the rotary movement of the kiln so that the fines fall back into the kiln whereas the coarses are fed to a discharge chute. It has also been suggested to incorporate a cylindrical screen, through which the solids to be discharged are passed so that the fines fall also back into the kiln whereas the coarses are discharged.

It is also known to design a part of the kiln wall as a screen. The fines fall through this screen whereas the coarses are discharged at the discharge end of the kiln.

In practice it has been found that these apparatus are subjected to rapid wear, resulting in breakdowns, owing to the elevated temperatures which are maintained, or they must be made from expensive materials which resist elevated temperatures. These disadvantages are mainly encountered when the process involves a movement of the solids and gas in a counter-current because the central burner disposed at the discharge end of the kiln gives rise to great difficulties from the design aspect and particularly high temperatures are present in that region. Another disadvantage resides in that part of the kiln space is lost for the reaction. Additional sealing problems will arise, if they require that the screened fines to be discharged are cooled under reducing or neutral conditions.

The apparatus according to the invention enables a hot screening of the solids discharged from rotary kilns at temperatures of 400–1200° C., particularly of solids comprising iron ore pellets, under neutral or reducing conditions, whereas the disadvantages of the known apparatus are avoided. The invention provides essentially a frusto-conical screening drum, which is rotatably mounted in a cooling drum, said screening drum having in known manner an open large end and a closed small end. The shell of the screening drum is formed by parallel pairs of carrying bars, between which the screening bars are inserted in succession. It is preferred to use grate bars, as are known from the conventional sintering machines. The

spaces between the carrying bars are closed by covering sheets, which are preferably provided with obstructing baffles or the like that prevent a smooth rolling of the pellets. The closed end of the screening drum is preferably closed by a cap, which has a cylindrical outer rim serving as a support for the carrying bars. For use at very high temperatures, the top of the cap is preferably dished to avoid warping. The screening bars are set to define the desired free screen openings by spacing elements or by cams cast integrally with the screening bars. The screening drum is arranged so that its axis is at an angle of about 0–30° to the horizontal. The conical wall of the screening drum may include an angle up to about 30° with the horizontal.

According to one aspect, the invention provides apparatus for screening a hot solid particle size mixture, which comprises, in combination, a rotary cooling drum having an entrance end portion, and a rotary screening drum extending in said entrance end portion, said screening drum being frusto-conical and having a closed small end disposed axially inwardly with respect to said cooling drum and an open large end disposed axially outwardly with respect to said cooling drum, said screening drum having a lower generatrix which is downwardly inclined toward said large end.

According to another aspect, the invention provides a rotary kiln installation, which comprises a rotary kiln having a discharge end adapted to discharge a hot solid particle size mixture, a rotary cooling drum having an inlet end portion, a screening drum rotatably mounted and extending in said entrance end portion, said screening drum being frusto-conical and having a closed small end disposed axially inwardly with respect to said cooling drum and an open large end disposed axially outwardly with respect to said cooling drum, said screening drum having a lower generatrix which is downwardly inclined toward said large end, and feeding means for feeding said mixture from said discharge end of said kiln into said large end of said screening drum.

According to a further aspect, the invention provides a process of recovering hot coarses from a hot solid particle size mixture, which comprises screening said mixture in the entrance portion of a cooling zone to obtain fines and coarses, feeding said fines through said cooling zone, and feeding said coarses out of said cooling zone at said entrance portion thereof.

In a preferred embodiment of the invention, the distance from the ends of the grate bars to the retaining cams on the grate bars exceeds the thickness of the supporting portions of the carrying bars. This arrangement results in a self-cleaning action of the screening bars as the screening bars can fall twice through a distance corresponding to the resulting clearance under gravity during each revolution of the screening drum.

The screening drum is suitably arranged below the discharged end of the rotary kiln so that the discharged solids fall through a well and along a chute into the screening drum. The closing cap is suitably provided as a wearing member.

In the accompanying drawings, an embodiment of the invention is diagrammatically shown by way of example in an arrangement, in which the screening drum is mounted under a reducing rotary kiln for reducing iron ore pellets.

FIG. 1 is a sectional view showing the discharge end of a rotary kiln with transfer chambers, the inlet end of a cooler and an incorporated conical screener.

FIG. 2 shows a specific design of a conical screener in the inlet of the cooling tube.

FIGS. 3 and 4 are diagrammatic fragmentary views showing the mounting and position of the grate bars at the top and bottom of the screening drum.

A rotary kiln **1** has a discharge end **2**, which extends into a discharge end frame **3**. A seal **4** seals the rotary kiln and a cooler from the end frame and a transfer chamber. A burner **5** extends centrally into the interior of the rotary kiln through the end wall of the end frame **3**. Solids discharged from the rotary kiln **1** fall through the end frame **3** and a connecting part **6** into a feeding chamber **7**. A feeding chute **10** is associated with the feeding chamber **7** and extends into an entrance end **8** of a cooling drum **9**. A conical screener **11** provided with an end cap **12** is mounted in the entrance end **8** of the cooler **9**. The screening drum **11** is connected to the cooler **9** for joint rotation. The cooling drum **9** is provided with a gear **18**, which is in mesh with pinion means, not shown, for rotating the cooling tube **9** and with it the screening drum **11** about a common axis.

The feeding chute **10** feeds the solids into the screening drum **9**. The fines pass through the openings in the screening drum **11** into the interior of the cooling drum **9**, where they are conveyed and cooled. The coarses are discharged from the screening drum **11** into the bin **13**, where they are available at elevated temperature for further use.

With reference to FIG. 2, the cooling drum **9** contains the conical screener **11** having an end cap **12**. Carrying bars **14** are connected between an end flange **15** of the cooling tube and the end **12**. Wedge-shaped cover plates **16** are disposed between the carrying bars. The screening areas between the carrying bars **14** are formed by grate bars **17**.

The carrying bars are arranged in pairs of parallel bars **14**. The cover plates **16** are disposed between the adjacent carrying bars of adjacent pairs thereof. The cap **12** has an outwardly convex top.

The inside surfaces of the cover plates **16** are provided with baffles **19**, which obstruct a movement of the solids in the circumferential direction of the screening drum **11** but facilitate a movement of the coarses toward the large end of the drum.

The carrying bars **14** are T-sections having web portions **20**, which interengage with the screening or grate bars **17**. Each screening bar **17** has two end portions **21**, which are enlarged in the radial direction of the drum **11**. At the end face of the screening bar **17**, the enlarged end portion **21** is formed with a recess **22**. The width of this recess **22** in the radial direction of the drum **11** exceeds the thickness of the web portion **20**, which is received by said recess. The screening bars **17** are thus mounted on the carrying bars **14** with a freedom of limited movement in the radial direction of the drum **11**. During each revolution of the drum **11**, the screening bars **17** will successively assume the positions shown in FIGS. 3 and 4. This results in a self-cleaning action of the screening bars **17**.

The axis of the screening drum **11** is horizontal or downwardly inclined toward its closed end at an angle of up to 30° with respect to the horizontal. The screening drum **11** is coaxial with the cooling drum **9**.

The lowermost generatrix of the screening drum **11** is downwardly inclined toward the open end of the drum at an angle of up to 30° with respect to the horizontal.

The apparatus according to the invention enables a screening of solids discharged from a rotary kiln at elevated temperatures of 400–1200° C. in a technologically and economically suitable manner and, if desired, with exclusion of air. The use of grate bars as screening bars results in a long life, substantially reduces the costs of the structure and provides for a self-cleaning action.

Another important advantage resides in that defective grate bars can be replaced quickly and simply by new bars and there is no need to replace entire screening plates, as in the known apparatus.

In the case of light-duty operations, the screening bars may be replaced by perforated or screening plates or the like.

What is claimed is:

1. Apparatus for screening a hot solid particle size mixture comprising a rotary cooling drum having an entrance end portion, and a rotary screening drum extending in said entrance end portion, said screening drum having a conical surface formed by pairs of parallel carrying bars and grate bars mounted between the carrying bars of each pair of carrying bars, recesses in the ends of said grate bars with each recess having a width greater than the thickness of the carrying bar upon which it is mounted, cover plates mounted between alternate pairs of carrying bars, said screening drum having a closed small end disposed axially inwardly with respect to said cooling drum and an open large end disposed axially outwardly with respect to said cooling drum, said screening drum being downwardly inclined toward said large end, and baffle means mounted on said cover plates for obstructing movement of particle solids in the circumferential direction of said screening drum while facilitating movement of solids retained on said screening drum toward said open large end.

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209—297; 263—32