United States Patent

Goldberg

[15] **3,667,691**

[45] **June 6, 1972**

[54] METHOD FOR CRUSHING METAL TURNINGS

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[52] **U.S. Cl.** **241/24,** 241/29

[51] **Int. Cl.** **B02c 21/00**

[58] **Field of Search** 241/24, 29, 30, 68, 81, 200

[56] **References Cited**

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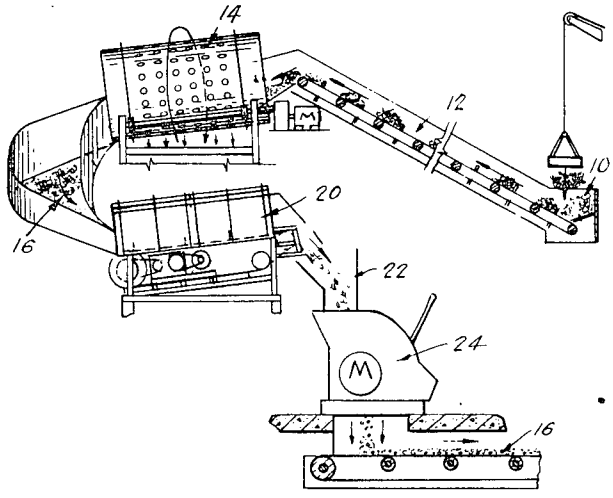
[57] **ABSTRACT**

In the crushing of metal turnings, the turnings are first passed through a centrifugal separating drum where the fines and solid chunks are separated from the clusters of turnings. The chunks are removed, and the clusters of turnings are then passed to a shredding apparatus, which includes an endless chain conveyor, mounting teeth for advancing the clusters of metal turnings towards the crusher or pulverizer and stationary teeth spaced above the conveyor and cooperating with the teeth on the conveyor for shredding the large clusters of metal turnings as they are advanced towards the crusher or pulverizer.

2 Claims, 11 Drawing Figures



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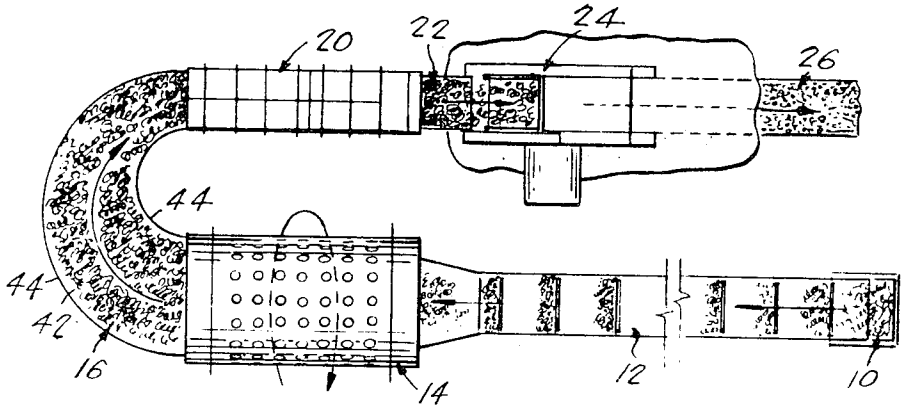

FIG. 1

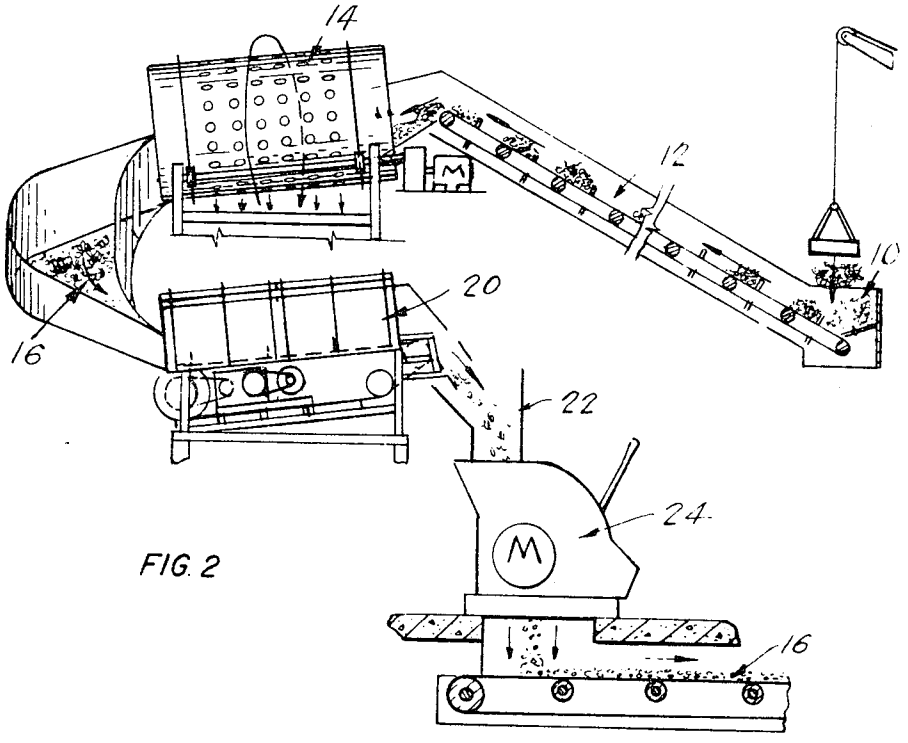

FIG. 2

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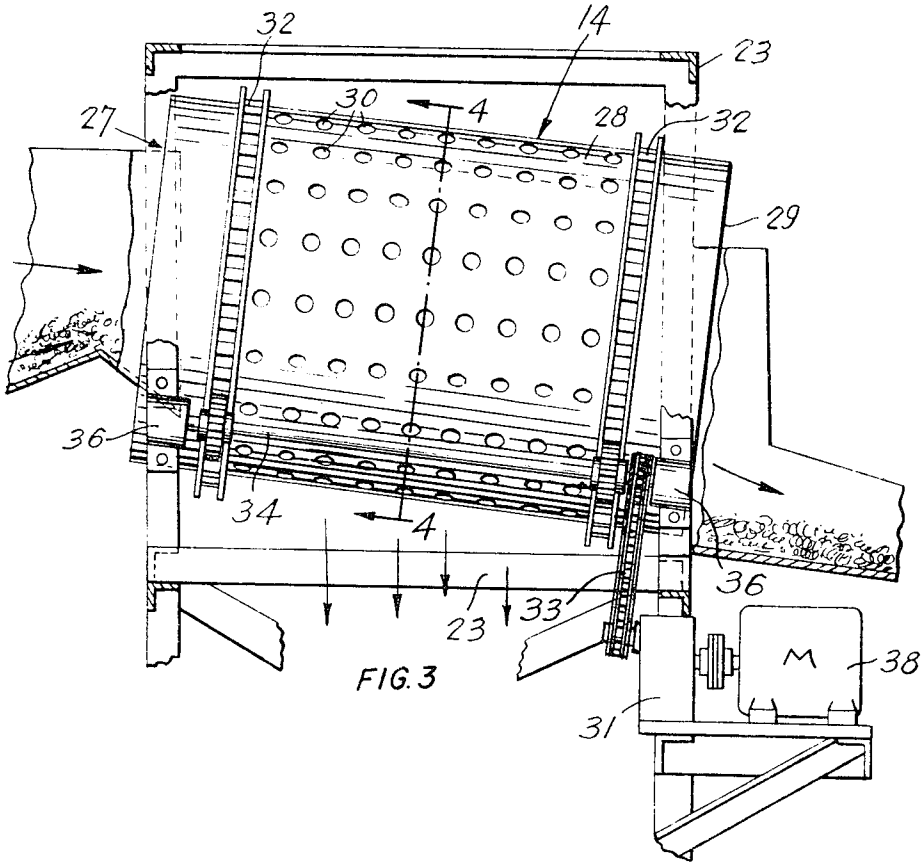

FIG. 3

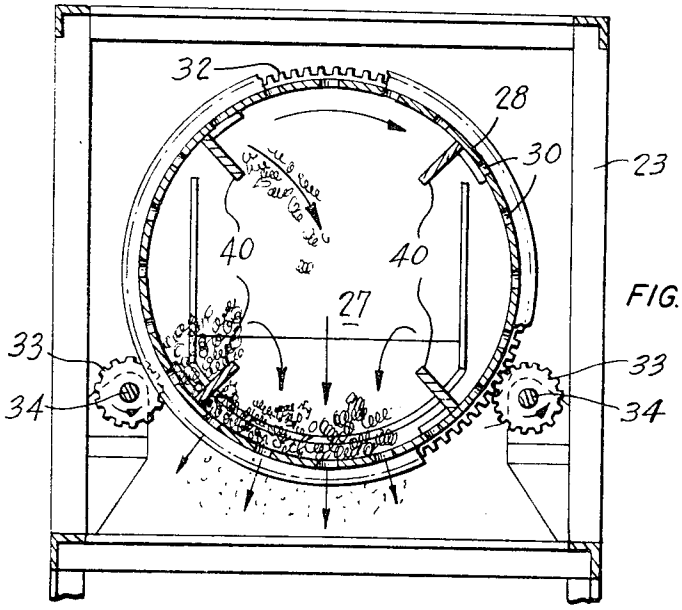

FIG. 4

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FIG. 5

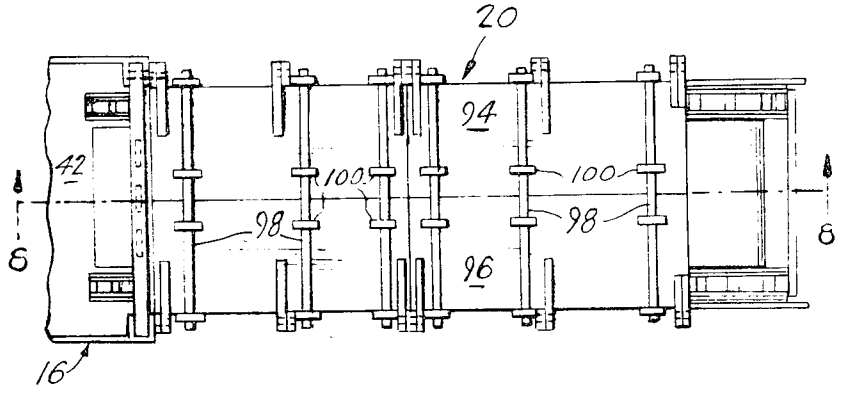

FIG. 6

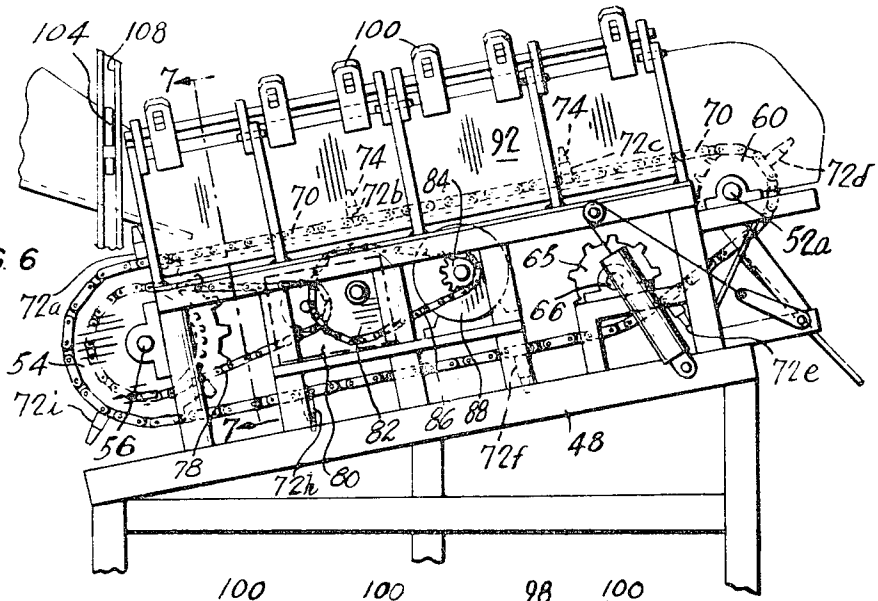

FIG. 7

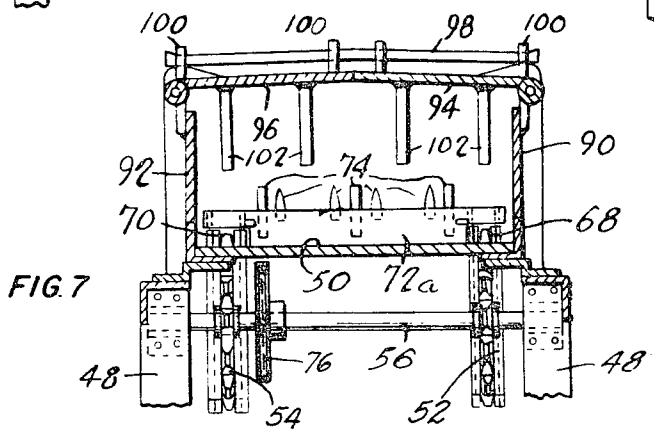

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FIG. 8

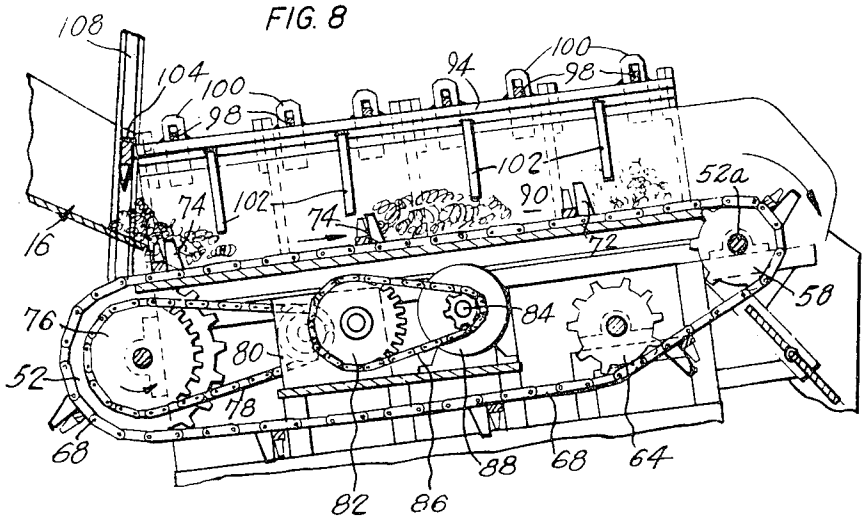
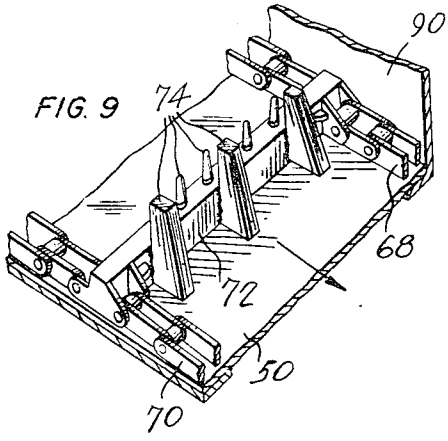


FIG. 9



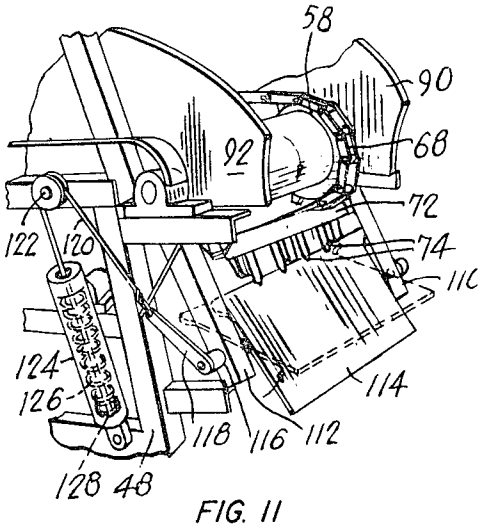


FIG. 11

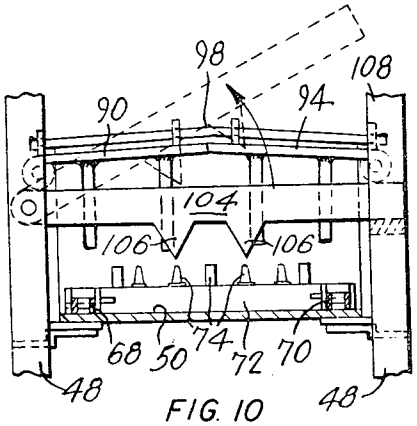


FIG. 10

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METHOD FOR CRUSHING METAL TURNINGS

BACKGROUND OF INVENTION

1. Field of Invention

The present invention relates to a method and apparatus for reducing metal turnings to fines which can be economically handled and remelted. 2. Description of the Prior Art

Metal turnings, that is the waste metal formed by drilling, milling, or machining metal, is naturally very difficult to handle, since it clusters in bushy bunches which have a relatively low weight per unit volume as compared to solid scrap for example. Furthermore, the material is not suitable for charging into a furnace for remelting, unless it is in free-flowing shovelling size. It is therefore necessary to crush or shred the turnings to grain or pellet size pieces, known as fines, in order to reduce the volume thereof and to facilitate magnetic or other separation. Since the metal turnings are picked up from machine shop floors and the like, they are usually a mixture of different metals having different physical properties. For instance, in one cluster of turnings there may be soft aluminum turnings mixed with spring steel turnings, thus complicating the crushing operation. Crushers used for shredding or crushing, pulverizing or grinding metal turnings are for example, of the type shown in U.S. Pat. Nos 1,862,889 and 1,947,700 to the American Pulverizer Co. Although crushers of this type are very effective in crushing metal turnings they may break if heavy solid pieces are mixed or hidden in the turnings, and are often jammed when a relatively large cluster of bunched metal turnings passes into the crusher. It is then necessary to literally dismount the crusher for repairs or to remove the cluster which has jammed it.

On the other hand, if solid chunks are removed and the size of the clusters of bunched metal turnings are controlled in size and the rate at which they are being fed, then the frequency of breaking or crusher jamming can be greatly reduced or eliminated.

OBJECT OF THE INVENTION

It is an aim of the present invention to provide an apparatus and method of removing the solid chunks and reducing the sizes of said clusters and to control the rate at which the metal turnings are fed to the crusher.

A construction in accordance with the present invention comprises conveying means for conveying the metal turnings. The conveying means includes teeth adapted to engage the metal turnings, support means opposed and spaced from said conveying means and teeth mounted on said support means. The latter teeth are adapted to engage large clusters of bunched metal turnings, whereby there is relative longitudinal movement between the teeth on said conveying means tending to shred the clusters engaged by the teeth on the conveying means and the teeth on the support means.

In a preferred embodiment, the above-mentioned apparatus is located immediately preceding a metal turnings crusher whereby the size and rate of the metal turning and clusters to the crusher can be controlled. In a preferred embodiment it is also contemplated to pass the metal turnings first through a rotating perforated drum whereby the metallic fines already formed are discharged centrifugally from the drum and can be collected and only the solids and clustered turnings will be separated and discharged axially onto an inspection table whereby the solids can be seen and removed and the clusters advanced by gravity towards the conveying means.

A method in accordance with the present invention includes the steps of passing the metal turnings through a separator stage where the fine loose metal turnings are separated from the solid chunks and the clusters, removing the solids, and passing the remaining clusters of metal turnings to a conveyor station, conveying the metal turnings forward towards a crushing station, shredding the large clusters of metal turnings as they are being advanced, whereby the large clusters are reduced to a size suitable for crushing and finally crushing the metal turnings.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus generally described the nature of the invention, particular reference will be made to the accompanying drawings showing by way of illustration, preferred embodiments thereof and in which:

FIG. **1** is a schematic plan view illustrating one embodiment of the invention;

FIG. **2** is a schematic elevation of the arrangement shown in FIG. **1**;

FIG. **3** is a side elevation of a detail shown in FIG. **1**;

FIG. **4** is a vertical cross section taken along the lines **4**—**4** of FIG. **3**;

FIG. **5** is a top plan view of another detail taken from FIG. **1**;

FIG. **6** is a side elevation of the detail shown in FIG. **5**;

FIG. **7** is a vertical cross section taken along lines **7**—**7** of FIG. **6**;

FIG. **8** is a vertical cross section taken along lines **8**—**8** in FIG. **5**;

FIG. **9** is a fragmentary perspective view of a detail of the apparatus shown in FIGS. **5** through **8**;

FIG. **10** is an end elevation taken through the intake end of the apparatus shown in FIGS. **5** through **8**; and

FIG. **11** is a perspective view of the discharge end of the apparatus shown in FIGS. **5** through **8**.

Referring now to FIGS. **1** and **2**, the combination shown includes a raw material intake hopper **10** in which the metal turnings are fed, while the conveyor **12** conveys the metal turnings from the hopper **10** towards the rotating separator drum **14**. The material which has not been discharged from the separating drum **14** is discharged onto an inspection table **16** which is in the form of a slide which conducts the metal turnings by gravity from the separating drum **14** to the shredding apparatus **20**. A shredding apparatus which reduces the sizes of the clusters of bunched metal turnings and discharges the metal turnings into a delivery chute **22** which in turn conducts the metal turnings into a crusher **24** is provided. Any suitable crusher, pulverizer or grinder can of course be used. Discharge from the crusher **13** falls onto a discharge conveyor **26** which carries crushed turnings as well as the fines from the separating drum **14** towards a subsequent step which can include a storage bin or conveyance.

Referring now to FIGS. **3** and **4**, a separating drum **14** is shown having an intake **27** and a discharge **29**. The separating drum **14** includes a cylindrical drum **28** having a plurality of apertures **30**. Gear tracks **32** are provided near each end of the cylinder **28** and are adapted to be engaged by gears **33** fixed to drive shafts **34** on either side of the cylinder **28**. The drive shafts **34** are journalled for rotation in bearings **36** (and are driven by a motor **38**), via gear box **31** and chain and sprocket drive **35**.

In operation, as the metal turnings are fed from the conveyor **12** into the intake end **27** of the separating drum **14**, they are rotated within the drum and are caused to jog around in the cylindrical drum **28** by means of deflector plates **40**. The fines are discharged through the apertures **30** while the solid chunks are separated from the clusters by centrifugal force.

The remaining clusters of metal turnings and solids are discharged through the discharge opening **29** of the separating drum **14** by gravity since the axis of the separating drum is inclined onto an inspection table **16** which is in the shape of a curved chute which is also inclined to allow the clusters of metal turnings to slide downwardly towards the intake end of the shredding apparatus **20**. The inspection table **16** includes a smooth table surface **42** which is curved and inclined as shown in FIG. **1** and mounts side walls **44** to prevent the metal turnings from falling off the inspection table **16**. While the clusters of metal turnings advance on the inspection table **16**, the operator can at this stage remove any metallic chunks which would normally not have to be crushed by the crusher and which would unnecessarily burden the crushing operation or break the crusher. The shredding apparatus **20** (as shown in

FIGS. 5 to 11) is mounted on a frame 48 and includes an upwardly inclined smooth table surface 50. Driven chain engaging gears 52 and 54 are provided at the intake end of the shredding apparatus 20. These driven chain engaging gears 52 and 54 are fixed at each end of a driven shaft 56. Idler gears 58 and 60 which are mounted on an idler shaft 52*a* are provided at the other end of the table surface 50 and idler gears 64, 65 mounted on the shaft 66 are spaced downwardly slightly from the idler gears 58 and 60. Endless chains 68 and 70 are located about the gears 52, 58, 64 and 54, 60 and 65 respectively. Lateral bars 72*a*, 72*b* to 72*i* are connected laterally to the respective endless chains 68 and 70 as shown in FIGS. 7 and 9. A plurality of upwardly extending teeth 74 are welded to the lateral bars 72.

A drive gear 76 is fixedly connected to the drive shaft 56 which mounts the driven chain engaging gears 52 and 54 and is in turn driven by a chain 78 connected to a gear mounted in reduction box 80. Large gear 82 driven by chain 86 passing about the large gear 82 and a smaller gear 84 drives the gearing in the reduction box 80 and is in turn driven by a motor 88.

Side walls 90 and 92 are provided on either side of the inclined table surface 50 and are structurally reinforced to mount hinged top wall halves 94 and 96. These hinged top wall halves are adapted to open outwardly pivoting about the upper edge of the side walls 90 and 92 respectively to expose the inclined table surface 50 as well as the chains 68, 70 and the teeth 74. In its operating position hinged top wall halves 94 and 96 are normally closed over the inclined table surface 50 and are locked there by means of locking bars 98 passing through apertures in projections 100 on the exterior surface of the table top halves 94 and 96. Each table top half 94 and 96 mounts downwardly extending projecting teeth 102 which are interspaced with the upwardly extending teeth 74. These teeth 102 are of course stationary in the present embodiment while the teeth 74 on the bar 72 are adapted to move longitudinally forward relative to the stationary teeth 102. As clusters of bunched metal turnings are fed into the intake end of the shredding apparatus, the teeth 74 engage these clusters to advance them forward along the inclined table surface 50. However, downwardly extending teeth 102 which are spaced upwardly a predetermined distance from the inclined table surface 50 and also engage the clusters which are too large and the relative movement of the teeth 74 relative to the teeth 102 causes the clusters to be shredded or at least break up into smaller clusters. These smaller metal turning clusters are then discharged by the teeth 74 mounted on bar 72 into a discharge chute 22.

In order to control the rate of feed of the clusters of metal turnings into the crusher, a guillotine arm 104 is pivotally mounted at the intake end of the shredding apparatus 20. The guillotine arm 104 mounts a plurality of teeth 106 and the free end of the guillotine arm 104 moves in the guide slot 108 provided on the opposite lateral side of the shredding apparatus intake end. When it is required to reduce the feed of metal turnings into the crusher, the guillotine can be lowered into a position shown in FIG. 10, causing the clusters of metal filings to back up on the inspection table 16. The guillotine arm 104 can be manually operated and in the case of an extremely large cluster of metal turnings, it can be used too as a means to reduce the size of the cluster as it enters the intake end of the shredding apparatus.

At the discharge end of the shredding apparatus, there is provided a pair of frame extension arms 110 and 112. A pivot shaft 116 is mounted for rotation between the arms 110 and 112 and fixedly mounts a pivoting baffle plate 114. A lever arm 118 is fixedly connected to the pivot shaft 116 and is attached to a rope 120 which in turn passes over a pulley 122 and is connected to a collar 128 in a counterweight housing 124 and either mounts a plurality of weights or works against a spring 126 as shown in the present embodiment.

The pivoting plate 144 is normally in a vertical position but as a set of teeth 74 on a bar 72 passes they abut against the plate 114 causing it to pivot resiliently against its counterweight system. This pivoting plate 114 acts to clean the conveyor chains 68 and 70 of the metal turnings which tend to move along the return run of the endless chain 68 and 70/72 and 74.

The metal turnings are discharged in the discharge chute 22 and enter the crusher 24. The crusher 24 is not shown here in detail but can be of the type mentioned above with respect to U.S. Pat. Nos. 1,947,700 and 1,860,889.

From the apparatus described in the present embodiment, it can be seen that the metal turnings, which are normally bunched in clusters, will have been reduced in size, if they are oversized, by means of the shredding apparatus 15, and they will have been previously cleaned of fines and metal chunks as they pass through the separating drum 14 and the inspection table 16.

I claim:

1. A method of reducing metal turnings to fines which can be economically handled and remelted, including passing the metal turnings through a separating stage wherein the metal turnings are subjected to centrifugal force in an attempt to separate the fines and chunks from the metal clusters, removing the chunks, passing the remaining clusters through a conveyor station, conveying the metal turnings in said conveyor station to a crushing station, shredding large clusters of metal turnings as they are being advanced towards the crusher whereby the large clusters are reduced to a size suitable for crushing, finally crushing the metal turnings to fines.

2. A method as defined in claim 1, wherein the step of shredding large clusters of metal turnings at the conveyor station includes partially retaining the clusters and partially gripping the same clusters by the conveyor so as to reduce the size of the clusters by such shredding.

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