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HAMMER FOR HAMMERMILL

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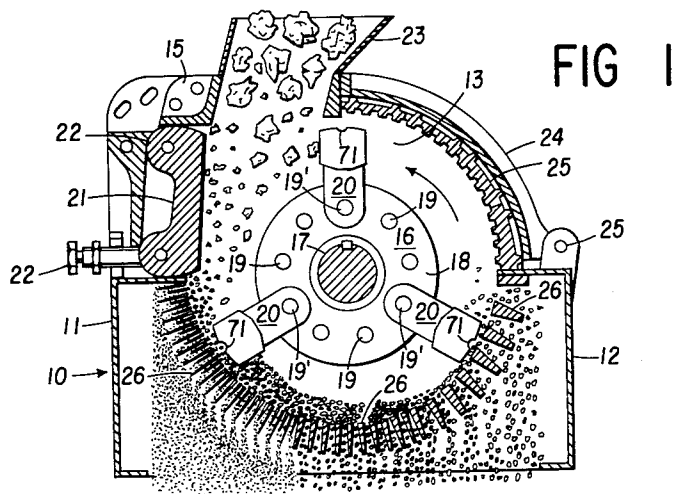


FIG 1

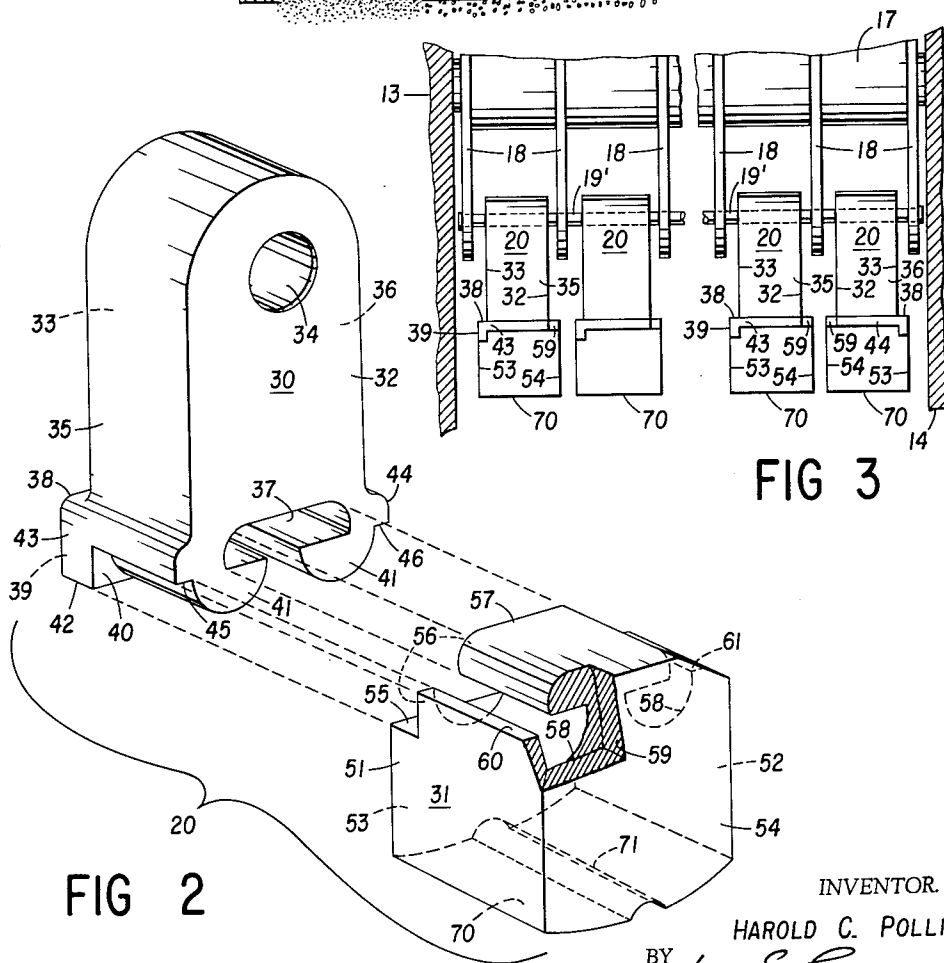


FIG 3

FIG 2

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HAMMER FOR HAMMERMILL

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The present invention concerns hammermills and particularly a means of removably attaching replaceable tips to the hammers thereof and of maintaining the tips thereon during operation of the mill.

Owing to the high rate of wear of the hammer ends in a typical hammermill it is customary to construct each hammer itself in two parts, a permanent hammer arm and a replaceable tip therefor. Many ways have been devised to attach the tip to the arm so that former may be removed as easily as possible and in the least possible time. Whatever the way employed, the most important thing is to avoid having first to remove the entire hammer itself from the mill before the tip may be detached therefrom. For this purpose the prior art illustrates a wide variety of detachable joints between the arms and tips, but these usually additionally require various locking means, such as bolts, keys, cotter pins, retaining plates and the like. But such all add to the complexity and cost of the hammer assembly itself and also increase the time and labor necessary to change tips. Furthermore, especially when an interlocking joint is used between the hammer arms and tips, fine dust finds its way into the joint during crushing and causes "liming" of the tip to the arm, greatly increasing the difficulty of removing the former.

In order to cut tip removal time and effort to a minimum and to reduce the cost and complexity of the hammer assembly itself, the present invention provides a simple interlocking joint between the hammer arm and tip so that the latter is attached or removed, as the case may be, simply by sliding it transversely of the hammer arm. Additionally, the joint, which may be of the T-shaped variety, is formed so that when the arm and tip are assembled, an integral wall on the arm at one transverse end of the joint overlaps the latter so that both transverse ends of the joint are closed to access by fine dust in order largely to prevent any "liming" between the arm and tip during crushing. Furthermore, the outer faces of the arm and tip end walls are located so that when, as is customary, a row of several hammers are swingably mounted side by side on a common axis, the outer surfaces of the end walls of adjacent hammers oppose and are closely spaced from each other. Accordingly, since centrifugal force arising from rotation of the hammermill spinner to which the hammers are attached maintains the row of hammers substantially side by side during operation, the aforesaid opposed, closely spaced end walls prevent accidental detachment of any of the tips from the hammer arms. This is accomplished no matter how the inner hammers of the row may be mounted on their axis; however, the two outer hammers at each end of the row must be mounted with their arm end walls facing the respective adjacent end walls of the hammermill itself in order to prevent any transverse movement of the tips sufficient to strike the end walls of the mill. When the mill is stopped, the hammers may be rotated on their axis with respect to each other and the tips simply and quickly knocked off for replacement, thus greatly reducing labor and shut-down time. Finally, the construction of the present invention also provides several collateral advantages, namely, the arm and tip end walls add to the strength of each and particularly to that of the joint therebetween, maximum weight is carried in the hammer tip itself, and loss of metal on the latter does not weaken the joint.

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Accordingly, the primary object of the present invention is to provide a transverse joint between the arm and removable tip of a hammer for a hammermill which both increases the strength of the arm, tip and joint and the weight of the tip and which incorporates means at each end of the joint and integral with the arm and tip both to close the ends of the joint and to maintain the tip on the hammer during operation of the mill when several hammers are mounted side by side on a common axis.

A further object of the present invention is the provision of a hammer arm and removable tip for a hammermill having an interlocking joint therebetween, the tip being slideably disengageable by movement thereof transversely of the direction of the operative movement of the hammer in the mill, the arm being provided with a wall at one transverse end of the joint closing that end and the tip being provided with a complementary wall at the other transverse end of the joint closing that end in order to reduce access to the joint by dust during operation of the mill and to provide means to retain the tip on the arm when several hammers are operatively assembled side by side on a common axis in the mill.

Other and further objects, features and advantages of the present invention will become apparent from the preferred form thereof hereafter described read in conjunction with the following drawings, in which:

FIGURE 1 is an end elevational view of a typical hammermill with one end wall removed;

FIGURE 2 is an exploded, perspective view of a hammer arm and removable tip employing the features of the present invention; and

FIGURE 3 is a side elevational view of a portion of the hammermill of FIGURE 1 illustrating several of the hammers shown in FIGURE 2 mounted according to the present invention.

Inasmuch as hammermills generally, as well as their operation, are well known (see, e.g., U.S. Patent No. 2,563,958 to Pollitz), only a relatively brief discussion thereof is needed here as a setting for a more detailed description of the present invention. The hammermill illustrated specifically in FIGURE 1 is of a well-known, conventional type employing an upright, generally rectangular housing 10 having side walls 11 and 12, end walls 13 and 14, top frame 15 and an open bottom. A spinner assembly 16, axially mounted on a heavy, horizontal shaft 17 journaled at each end in end walls 13 and 14 and driven by suitable means (not shown) in the direction of the arrow in FIGURE 1, is centrally disposed within housing 10 between end walls 13 and 14. Spinner assembly 16 comprises a row of disc-like members 18 extending radially of shaft 17 and spaced axially therealong. Several sets of holes 19 through discs 18 are spaced about and from shaft 17, each set being axially aligned to receive a horizontal hammer mounting pin 19' therethrough, suitably secured against axial movement, upon which a row of hammers 20 are journaled at their inner radial ends, each hammer 20 of each row being straddled by a pair of adjacent discs 18, the spacing between the latter being somewhat greater than the overall transverse dimension of each hammer 20. A stationary breaker and feed assembly, in the form of a generally cylindrical cage-like structure, is disposed in housing 10 substantially about and spacedly from the entire peripheral path of the outer ends of hammers 20 during rotation of spinner assembly 16. The breaker assembly extends rectilinearly between end walls 13 and 14 parallel to shaft 17, and includes several separate portions. Considering first those located above shaft 17, a generally upright breaker plate 21 is disposed just below the edge of top frame 15 adjacent side wall 11 so that its breaker face is operatively spaced from and opposite hammers 20 when the latter are substantially at the uppermost point

in their travel. The inclination of breaker plate 21 is made adjustable for well-known reasons by suitable means 22. To the portion of top frame 15 immediately above the space between breaker plate 21 and hammers 20 at their aforesaid point is attached a feed chute 23 and the remainder of the space between feed chute 23 and side wall 12 is closed by an outwardly convex cover 24, horizontally hinged at 25 adjacent the top edge of side wall 12 for access to the interior of housing 10. The inner surface of cover 24 carries a typical assembly of liner plates 25 extending transversely between end walls 13 and 14. Breaker plate 21, feed chute 23 and liner plates 25 thus surround the upper half of spinner assembly 16. The lower half thereof employs a series of grate bars 26 extending transversely between end walls 13 and 14 and spacedly positioned side by side to form an upwardly opening concave grate surface from the lower end of breaker plate 21 to the lower end of liner plates 25, but spaced much more closely to the path of travel of the outer ends of hammers 20 than the upper half in order to permit the hammer ends to mill or grind aggregate against grates 26, as described in the aforesaid patent to Pollitz. Grate bars 26 thus provide communication with the open bottom of housing 10, and if desired, for well-known purposes, the spacing of the individual bars 26 may be progressively increased and changed to meet the gradation requirement of the aggregate produced.

Turning next to the individual hammers 20 themselves and with reference to the position thereof illustrated in FIGURES 2 and 3, each hammer comprises a hammer arm 30, generally rectangular in cross section, and a removable hammer tip 31 of generally cubical shape. Arm 30 is formed with a pair of opposite, parallel side walls 32 and 33, spaced apart somewhat less than the spacing between adjacent discs 18, and perpendicularly bored at 34 adjacent the inner radial end of arm 30 to receive one of hammer pins 19' therethrough so that hammer 20 may be swingably mounted thereon. The remaining side walls 35 and 36 of arm 30 are also parallel and curvingly converge to round off the inner end of arm 30. The outer radial end of arm 30 is provided with a suitable, symmetrically shaped upright slot 37, generally of a "T" shape, having its "cross bar" horizontally and centrally disposed between side walls 35 and 36. T-slot 37 extends uniformly across arm 30 from side wall 32 parallel to side walls 35 and 36 to the plane of side wall 33, the upper corners of its "cross bar" being rounded. The end of T-slot 37 in the plane of side wall 33 is closed by an end wall 38 formed integrally with arm 30 and T-slot 37 and provided with an outer end face 39 spaced outwardly from and parallel to side wall 33 and an inner end face 40 in the plane of side wall 33 and forming the closed end of T-slot 37. The bifurcated end of arm 30 formed by T-slot 37 has the outer radial end of each half thereof forming its "stroke" portion also rounded to form a pair of laterally spaced retaining lips 41, extending from side wall 32 parallel to T-slot 37 to end face 40, in the form of depending half round sections having their inner lateral edges forming the juncture between the "cross bar" and "stroke" of T-slot 37 and their outer lateral edges lying in the planes of their respective adjacent side walls 35 and 36. The top of end wall 38 is radiused into side wall 33 and its bottom is horizontally faced at 42 flush with the lowermost points of retaining lips 41. The lateral faces 43 and 44 of end wall 38 are also preferably spaced outward from and parallel to side walls 35, 36, the portions thereof above retaining lips 41 being carried across side walls 35, 36 to side wall 32 to form with the outer lateral edges of retaining lips 41 a pair of downwardly facing shoulders 45, 46 extending in the same plane as the lower face of the "cross bar" of T-slot 37 from end face 40 to side wall 32.

Hammer tip 31 is formed with a pair of opposite, parallel side walls 51, 52 flush with lateral faces 43 and 44 of arm end wall 38, and a pair of opposite end walls

53, 54 parallel to outer face 39 of arm end wall 38 and spaced apart a distance equal to the thickness of arm 30 between side walls 32 and 33 thereof plus twice the thickness of arm end wall 38. The upper portion of tip end wall 53 equal to the height of arm end face 40 is relieved inwardly a distance equal to the thickness of arm end wall 58 to form a flat, horizontal upwardly facing seat 55 and a flat vertical end face 56 parallel to tip end wall 53. The remaining portion of the inner radial end of tip 31 is formed with a symmetrically shaped, integral T-rib 57, complementary to T-slot 37, having its "cross bar" and "rib" horizontally and centrally disposed between tip side walls 51, 52. T-rib 57 extends uniformly across tip 31 from end face 56 parallel to side walls 51, 52 a distance equal to the length of T-slot 37, terminating so as to provide a vertical inner end face 58 parallel to end wall 54. Accordingly, the upper portion of end wall 54 and end face 58 together provide an end wall 59, equal in thickness to arm end wall 38 and closing the adjacent end of T-rib 57. The upper portions of tip side walls 51 and 52 are also inwardly relieved to provide a pair of horizontal, upwardly turned seats 60, 61, spaced above seat 55 a distance equal to the height of shoulders 45, 46 above lower face 42 of arm end wall 38, the top of end wall 59 being beveled at each corner thereof downwardly to seats 60, 61. Thus when T-rib 57 is slideably fully engaged with T-slot 37, arm shoulders 45, 46 will register with and fully receive tip seats 60, 61, and lower face 42 of arm end wall 38 will register with and fully receive tip seat 55; end face 32 of T-slot 37 will abut or at least oppose inner end face 58 of end wall 59 and end face 56 of T-rib 57 will abut or at least oppose inner end face 40 of arm end wall 38; lateral faces 43, 44 of the latter will be flush with tip side walls 51, 52, respectively, and outer end face 39 of arm wall 38 will be flush with tip end wall 53, thus entirely closing the joint between arm 30 and tip 31. At the same time the outer face 54 of end wall 59 will be spaced outwardly of and parallel to arm side wall 32 the same distance outer end face 39 of arm end wall 38 is from arm side wall 33. Arm end wall face 39 and tip end wall 53, on the one hand, and tip end wall 54 on the other, thus form the maximum transverse dimension of each hammer 20, which dimension is approximately equal to the space between adjacent discs 18. Finally, the outer radial end or face of tip 31 is curved between side wall 51 and 52 on a radius swung from the axis of bore 34 in order to provide a milling or grinding surface 70 thereon. The latter in turn may be provided if desired, with a relatively shallow, concave groove 71 therein of half round section extending thereacross between end walls 53 and 54 midway between side walls 51 and 52 in order to aid the grinding action of hammers 20 against grate bars 26.

Mounting of hammers 20 on hammer pins 19' between adjacent discs 18 is accomplished in the usual manner. However, referring to FIGURE 3, it is necessary that the hammer at each end of each row of hammers on spinner assembly 16 be positioned with its outer end face 39 of arm end wall 38 facing the adjacent inner face of end wall 13 or 14, as the case may be, of housing 10. In this manner no transverse movement of tips 31 relative to arms 30 can cause interference of the former with end walls 13 or 14. The inner hammers of each row, on the other hand, may be positioned either way on their hammer pins 19', inasmuch as since during operation of the mill centrifugal force maintains the hammers of each row substantially side by side radially outwards of shaft 17, any transverse movement of tips 31, even enough for two adjacent tips to touch, will not impair the operation of the hammers themselves. Such transverse movement as may occur will be very little, owing to the close spacing of the adjacent end faces of the tips of adjacent hammers, thus insuring that each tip remains attached to its hammer arm even though no

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other securing device is used. Passage of the grinding ends 70 over grate bars 26 provides a progressive reduction in size of the aggregate initially shattered by hammers 20 or against breaker plate 21.

When the tips must be replaced, stopping the mill permits the individual hammers of each row to be rotated on their pins 19' relative to each other in order to expose end walls 53 of the tips. A blow on the latter will quickly detach the tip from the arm with little difficulty arising from "liming" of T-rib 57 in T-slot 37, owing to the closure of the transverse end of the T-joint by end walls 38 and 59 of arms 30 and tips 31, respectively. It will, of course, be understood that other suitable joints could be employed between arms 30 and tips 31 so long as they permit the closure of each transverse end thereof in the manner of the present invention. Thus, both from the standpoint of initial installation as well as from the standpoint of replacement, it will be apparent that the present invention provides a hammer arm and tip combination providing maximum ease of tip replacement and requiring a minimum of mill shutdown time and labor.

While the present invention has been described with reference to a particular embodiment and detailed descriptive language has been used, it is not so limited. Instead, the following claims are to be read as encompassing such modifications and adaptations of the invention as would ordinarily occur to one in the art.

I claim:

1. A hammer for use in a hammer mill comprising a hammer arm mountable adjacent one end for swinging movement in a first plane and a replaceable hammer tip removably secured radially outwards from the other end of said arm by means preventing detachment of said tip from said arm in a direction radially of the latter, said means including a slideably interlocking joint between the respective adjacent radially disposed ends of said arm and tip, said joint being formed by a contoured arm portion and a complementarily contoured tip portion, each of said portions being formed integrally with respectively said arm and tip so that said joint extends substantially across said arm and tip in a direction transversely of said first plane and being slideable with respect to each other in said last named direction in order to detach said tip from said arm, one pair of the respective opposite transverse ends of said portions being open to permit slideable disengagement of said portions and each of the other pair of the respective opposite transverse ends of said portions being closed by an end wall formed integrally therewith, said end walls forming the maximum transverse dimensions of said hammer relative to said first plane.

2. The device of claim 1 wherein each of said contoured portions extends across said arm and tip respectively in a direction substantially normal to the radial axis of said arm and wherein said joint provides the sole means to retain said arm and tip in interlocking assembled relationship.

3. The device of claim 2 wherein said tip end wall forms the whole of one of the transverse ends of said tip and lies in a second plane parallel to said first plane and said arm end wall and the face of the other transverse end of said tip each lie in a third plane parallel to said first plane with their respective adjacent edges both adjoining and flush with each other, and wherein the leading and trailing walls of said tip relative to swinging movement of said hammer each lie in a plane transversely of said first plane and both adjoin and are flush with the respective immediately adjacent portions of the leading and trailing walls of said arm.

4. The device of claim 3 wherein the contour of one of said portions is generally in the form of a T-shaped slot extending transversely with respect to said first plane of said adjacent end of said one portion, and wherein the contour of the other of said portions is generally in the

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form of a complementary T-shaped rib extending transversely with respect to said first plane of said adjacent end of said other portion and slidably engageable with said slot.

5. The device of claim 4 wherein the outer radially disposed end of said tip is provided with an arcuate grinding surface lying substantially in the path traversed by said tip end during swinging movement of said hammer and extending rectilinearly transversely of said first plane, said surface having a transversely extending groove therein facing radially outward from said surface and disposed substantially midway between the leading and trailing edges of said surface relative to swinging movement of said hammer.

6. In a hammer mill comprising an assembly having a spinner rotatable about a horizontal axis, at least one horizontal hammer axis on said spinner radially spaced from said spinner axis, and a plurality of hammers side by side on said hammer axis, each of said hammers comprising a hammer arm mounted at its inner radial end for swinging movement about said hammer axis in a vertical first plane relative to each other and to said spinner axis and a replaceable hammer tip secured to the outer radial end of said arm, said mill including a pair of stationary end walls having opposed inner faces, each face being adjacent said tip of the hammer at one transverse end of said hammer axis and parallel to said first plane; the combination therewith of means removably attaching each of said hammer tips to its respective hammer arm and preventing detachment of said tip from said arm in a direction radially of the latter, said means including a slideably interlocking joint between the adjacent radially disposed ends of said arm and tip, said joint being formed by a contoured arm portion and a complementarily contoured tip portion, each of said portions being formed integrally with respectively said arm and tip so that said joint extends substantially across said arm and tip in a direction transversely of said first plane and being slideable with respect to each other in said direction to detach said tip from said arm, one pair of the respective opposite transverse ends of said portions being open to permit slideable disengagement of said portions and each of the other pair of the respective opposite transverse ends of said portions being closed by an end wall formed integrally therewith, said end walls forming the maximum transverse dimensions of said hammer relative to said first plane, each pair of adjacent hammers on said hammer axis having their adjacent end walls opposing and closely spaced from each other effective to prevent slideable disengagement of said arms and tips during operative rotation of said spinner without need to employ additional means to prevent said disengagement, the hammer at each transverse end of said hammer axis having its arm end wall opposing and closely spaced from the hammermill end wall adjacent thereto.

7. The device of claim 6 wherein said tip end wall forms the whole of one of the transverse ends of said tip and lies in a second plane parallel to said first plane and said arm end wall and the wall of the other transverse end of said tip each lie in a third plane parallel to said first plane with their respective adjacent edges both adjoining and flush with each other, and wherein the leading and trailing walls of said tip relative to swinging movement of said hammer each lie in a plane transversely of said first plane and both adjoin and are flush with the respective immediately adjacent portions of the leading and trailing walls of said arm.

8. The device of claim 7 wherein the contour of one of said portions is generally in the form of a T-shaped slot extending transversely with respect to said first plane of said adjacent end of said one portion, and wherein the contour of the other of said portions is generally in the form of a complementary T-shaped rib extending transversely with respect to said first plane of said ad-

5 adjacent end of said other portion and slideably engageable with said slot.

9. The device of claim 8 wherein said hammermill includes a stationary grate assembly extending rectilinearly transversely of said first plane to abut said inner faces of said stationary end walls and having a plurality of transverse grate forming members, said grate assembly forming an upwardly opening concave grate surface disposed beneath said rotary assembly and closely spaced from the path of said hammers during operative rotation of said rotary assembly and wherein the outer radially disposed end of said tip is provided with an arcuate grinding surface lying substantially in the path traversed by said tip end during swinging movement of said hammer relative to its hammer axis and extending rectilinearly transversely of said first plane, said surface having a transversely extending groove therein facing radially outward from said surface and disposed substantially mid-

way between the leading and trailing edges of said surface relative to rotation of said rotary assembly.

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