May 30, 1961 F. J. BORON 2,986,349

FURNACE CHUNK BREAKER

Filed Oct. 30, 1959

FIG. 1

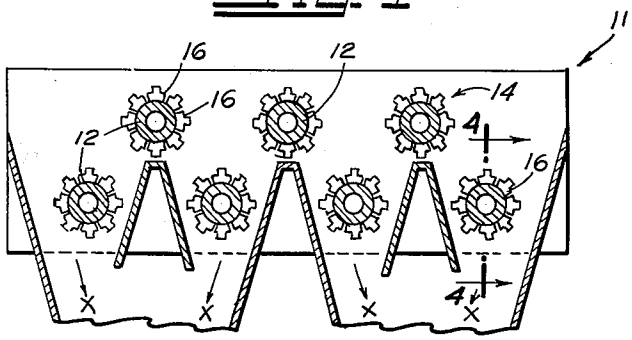


FIG. 2

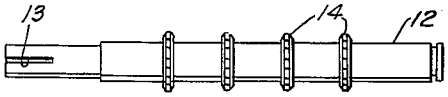


FIG. 3

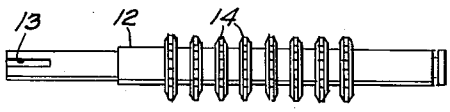


FIG. 4

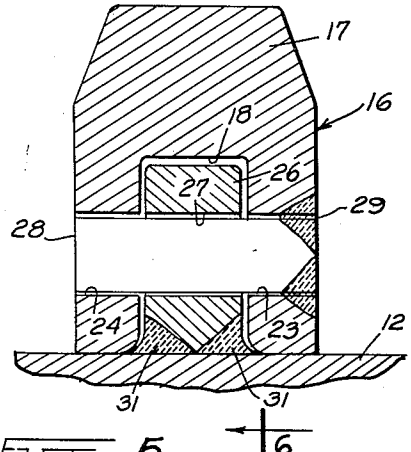


FIG. 6

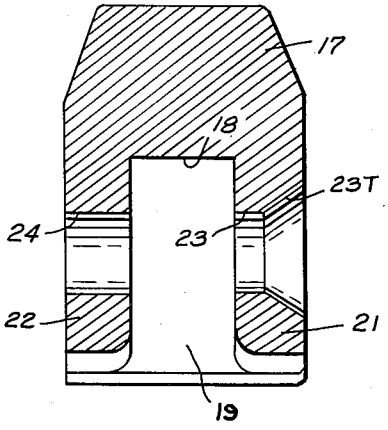
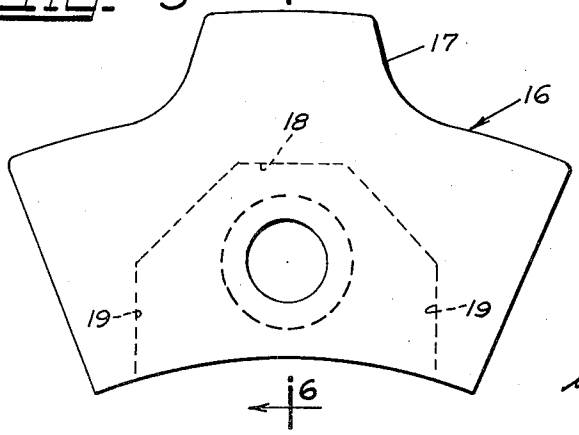


FIG. 5



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FURNACE CHUNK BREAKER

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7 Claims. (Cl. 241—294)

This invention relates to the construction of equipment for use in a furnace of the kind used to fire ore-bearing material or the like incidental to the processing of such material. More particularly, this invention relates to shafts mounting radially projecting teeth for breaking up hot chunks of the material processed and discharged from the furnace.

In furnaces of the foregoing kind it is conventional practice to arrange a plurality of shafts in parallel relation at the outlet of the furnace and to provide such shafts with a plurality of radially projecting teeth which are arranged in circumferentially extending and axially spaced bands about the periphery of the shafts. Thus, when the shafts are oscillated about their longitudinal axes, the teeth carried by the shafts are effective to break up and divide the hot chunks of material passing through the outlet of the furnace and between the shafts. Such shafts are usually of a hollow construction so as to enable a cooling liquid to flow therethrough to prevent an excessive temperature from being obtained in the material of which the shafts and teeth are composed. Heretofore, both the shafts and the teeth have been formed of steel in most instances, the teeth being formed as part of a disk which was affixed to the shaft. However, in recent years, the temperatures within such furnaces have been increased so that in order that the teeth, or disks, may have an appreciable life, it has become necessary to utilize a heat-resistant alloy as the material for such teeth and disks. Inasmuch as steel is considerably less expensive than such heat-resistant alloys, and also because steel is a good conductor of heat, it is desirable, and has been the conventional practice, to continue to utilize steel as the material for the shafts.

However, there exists a significant difference between the coefficients of thermal expansion of steel and heat-resistant alloys. As described in my copending application Serial No. 728,010, filed April 11, 1958, this difference in the expansion rate of the different materials and the temperature differential obtained by reason of the fluid cooling of the shafts has presented serious problems in thermal stressing of the alloy disk. Thus, by reason of the necessary juncture between the toothed disk and shafts, the differential temperature therebetween can cause distortion and cracking of the toothed disk, thereby rendering the disk ineffective to function as desired.

It is a primary object of this invention to obviate the problems heretofore encountered with such shaft and disk constructions by having resort to a disk of a segmented construction in which the individual segments are circumferentially spaced from one another and are loosely retained in position on the shaft so that there exists complete freedom for differential thermal expansion between the shaft and the disks.

In accordance with this invention a hollow cylindrical shaft, which is adapted to be water cooled, includes a plurality of lugs or key members which are arranged in circumferentially extending and axially spaced bands and

which are rigidly affixed to the circumference of the shaft, as by welding. A plurality of tooth-bearing segments are each formed with internal recesses which are so dimensioned as to receive an individual lug or key member therein. Each disk segment is retained in position on a lug or key member by a pin which is inserted through aligned apertures within the segment and the lug or key member and attached at one end only to the segment. The pin is of somewhat smaller overall size than the apertures in which it is received and thus enables the segment to be movable to a limited extent on the lug or key member. However, the relationship between the dimensions of the internal recess and the lug or key member is such that an inner surface of the recess in the segment abuts the lug or key member prior to such movement of the segment as would cause a stress to be developed in the retaining pin. Thus, forces engendered by a tooth encountering a chunk of material during oscillation of the shaft are transmitted as shear forces between the lug or key members and the shaft, while the retaining pin serves to retain the segments on the shaft during all phases of oscillation of the shaft but permits complete freedom of thermal expansion therebetween. It is another object of this invention to embody the foregoing arrangement in a novel manner in a chunk-breaker shaft for use in a furnace of the foregoing kind.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a sectional view of a hopper to be mounted beneath the furnace of the kind mentioned above, and shows in end view a plurality of shafts having breaker disks thereon constructed and arranged in accordance with the present invention;

Figs. 2 and 3 are side elevation views of the shafts shown in end elevation in Fig. 1 and illustrate constructions contemplated by the present invention;

Fig. 4 is a fragmentary sectional elevation view taken substantially in the direction of the arrows 4—4 in Fig. 1 and illustrates the details of the mounting of a disk segment on a shaft;

Fig. 5 is an end elevation view of an individual disk segment constructed in accordance with this invention; and

Fig. 6 is an elevation view, in section, taken in the direction of the arrows 6—6 in Fig. 5.

In Fig. 1 there is illustrated in sectional elevation a hopper assembly, designated generally by the reference numeral 11, which is adapted to be disposed adjacent the outlet of a furnace of the kind used to fire ore-bearing material or the like incidental to the processing of such material. The hopper assembly 11 includes a plurality of parallel shafts 12 which are adapted to be oscillated about their respective longitudinal axes. The shafts 12 are of a hollow construction so as to enable a cooling liquid to flow therethrough, and as illustrated in Figs. 2 and 3, are formed with slots 13 at one end thereof, which slots enable the shafts to be rotated by a key or like member inserted within the slots 13. The shafts 12 mount a plurality of disks 14 having tooth peripheries for engaging and breaking up hot chunks of material passing downwardly, in the direction of the ar-

row X in Fig. 1, through the ducts defined by the hopper **11**. As illustrated in Figs. 2 and 3, the breaker disks **14** may be axially spaced from one another by any predetermined amount dependant upon the specific application to which the shafts are to be applied.

Each breaker disk **14** is in actuality a series of individual segments **16** which are circumferentially spaced from one another and loosely retained in position on a shaft **12** in a manner now to be described.

With particular reference to Figs. 4–6, it is seen that a segment **16** is of a generally arcuate shape and includes a radially projecting tooth **17** on the outer periphery thereof. The inner periphery of the segment **16** includes a generally centrally disposed recess **18**. The recess **18** is defined by end abutment surfaces **19** and spaced-apart side sections **21** and **22** and is of a generally slot-like overall configuration. The side sections **21** and **22** are formed with respective apertures **23** and **24** which extend therethrough. Preferably one end of the aperture **23** may be tapered as illustrated at **23T** in Fig. 6.

With particular reference now to Fig. 4, it is seen that each shaft **12** has a plurality of lug or key members **26** affixed thereto. The overall dimensions of the lugs or key members **26** are slightly less than the corresponding dimensions of the recesses **18** in the segments **16** so that the lugs **26** are freely received within the recesses, and the segments are movable to a limited extent whenever a segment **16** is positioned on a lug **26** as illustrated in Fig. 4. Each lug **26** is formed with an aperture **27** which extends therethrough and which is substantially of the same size as the apertures **23** and **24** in a segment **16**. In the operative position of a segment **16** on a lug **26** the apertures **23, 27,** and **24** are aligned with one another with the inner periphery of the segment **16** residing on the exterior of the shaft **12**.

For the purpose of retaining the segment **16** in position on the shaft **12** during such periods as the segment may be moved to the underside of the shaft by the above-described oscillation of the shaft, retaining means, in the form of a pin **28**, are inserted within the apertures **23, 24,** and **27**. It should be noted that the diameter of the pin **28** is somewhat less than that of any of the apertures **23, 27,** or **24**, so that the limited relative movement afforded by the spacing between the surfaces of the recess **18** in the segment **16** and the lug **26** resulting from differential thermal expansion therebetween is in no manner hindered by the pin **28**. Also, and as will presently be described, the purpose of the pin **28** is to retain the lug **16** on the shaft during such periods as the lug **16** may be moved to the underside of the shaft but not to afford structure for transmitting stresses developed whenever a tooth strikes and breaks-up a chunk of material being discharged from the furnace.

The pin **28** is maintained in position within the respective apertures in the segment **16** and the lug **26** by weldment as **29** which attaches one end only of the pin **28** to the segment **16**, the other end of the pin being free within the aperture **24**. The tapered configuration **23T** of the aperture **23** facilitates the deposit of such weldment within the side section **21** of the segment **16**. Thus, the pin **28** is freely received within the aperture **27** in the lug **26** and the aperture **24** in the side section **22** of the segment, and this arrangement further assures freedom for relative thermal expansion between the segments **16** and the shaft and lug combination.

It should be noted that each lug **26** is preferably affixed to the shaft **12** by full penetrating welds **31** so as to enable the shaft to transfer a maximum of heat from the lug **26** and the welds **31**.

In the operation of the chunk breaker shaft and disk arrangement described hereinabove, the forces developed in the segments **16** by engagement with chunks of the material to be broken and divided while passing through the hopper **11** are transferred as shear forces on the respective lugs or key members **26**, and no stress is developed within the retaining pin **28** by reason of such operation of the shaft and disk arrangement. To accomplish this result, the spacing between the end abutment surfaces **19** of a recess **18** is related to the distance between the complementary abutment surfaces on the lugs or key members **28** such that the surfaces **19** are engaged with the lug prior to such movement of the pin **28** within the aperture **27** of the lug as would develop a stress within the pin **28**.

Thus, in accordance with this invention a plurality of segments **16** are mounted in a series of disk arrangements along the longitudinal axis of an oscillating shaft in a manner such that the individual segments are circumferentially spaced from one another and are free to expand or contract in response to variations in the ambient temperature independently of any dimensional variations in the shaft. Therefore, the segments may be composed of a heat-resistant alloy material while the shaft may be composed of less expensive steel which affords desirable heat transfer characteristics. Furthermore, even though the individual disk segments are loosely retained in position on the shaft so as to permit the aforesaid freedom of thermal expansion with respect to the shaft, the mounting arrangement incorporates radially projecting lug or key members affixed to the shaft in a manner such as to assure an adequate support for transferring between the disk segments and the shaft the forces which are encountered during operation.

Hence, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a chunk breaker of the type to be installed adjacent a furnace for breaking up hot chunks of material discharged from the furnace, a hollow support shaft adapted to be rotatably mounted and to be cooled by a fluid passed therethrough, a plurality of aligned key members fixed to said shaft in circumferentially spaced relation, a plurality of tooth-bearing segments, each enclosing one of said keys and composed of a heat-resistant alloy having a coefficient of thermal expansion different from that of said shaft, defining a breaker disk on said shaft for breaking up said hot chunks, and retaining means for loosely retaining the segments on said key members to minimize the transfer of thermal stresses between said segments and said shaft.

2. A chunk breaker as defined in claim 1 wherein each of said segments is formed with an internal recess so dimensioned as to receiving a key member therein and cause circumferential movement of said segments to be limited by abutment of a segment with a key member prior to the development of a stress in said retaining means.

3. In a chunk breaker of the type to be installed adjacent a furnace for breaking up hot chunks of material discharged from the furnace, a hollow support shaft adapted to be rotatably mounted and to be cooled by a fluid passed therethrough, said shaft having a plurality of aligned radially projecting key members affixed thereto, a breaker disk on said shaft including a plurality of circumferentially spaced apart segments each formed with a radially projecting tooth for engaging and breaking up said hot chunks and an internal recess for receiving a key member therein, and means for loosely retaining the segments on said key members to minimize the transfer of thermal stresses between said segments and said shaft, said means including a loose-fit connection for permitting a limited amount of radial movement of a segment with respect to the shaft.

4. A chunk breaker as defined in claim 3 wherein a segment and a key member are formed with aligned sub-

stantially equal size apertures and wherein said means include a pin of smaller diameter than said apertures and inserted within said apertures so that a segment is movable to a limited extent on a key member.

5. A chunk breaker as defined in claim 4 wherein said pin is affixed at one end only to said segment.

6. A chunk breaker as defined in claim 3 wherein a plurality of said breaker disks are axially spaced on said shaft.

7. In a chunk breaker of the type to be installed adjacent a furnace for breaking up hot chunks of material discharged from the furnace, a hollow support shaft adapted to be rotatably mounted and to be internally cooled by a fluid passed therethrough, a breaker disk encircling said shaft and including a plurality of circumferentially spaced apart segments each formed with a radially projecting tooth for engaging and breaking up said hot chunks and including spaced-apart rib sections defining opposite sides

of an internal recess formed within each segment, a plurality of keys fixed to said shaft and each adapted to be received within a recess in one of said segments to mount an individual segments thereon, and a pin fixed at one end to one rib section of a segment and freely passed through a key and the opposite rib section of the segment for loosely retaining each segment on a key to minimize the transfer of thermal stresses between said segments and said shaft.

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