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Urschel

[11] **3,823,880**

[45] **July 16, 1974**

[54] **MACHINE FOR REDUCING THE SOUND LEVEL OF ITS OPERATION**

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[52] **U.S. Cl.** **241/86,** 241/27, 241/95, 241/275, 259/96

[51] **Int. Cl.** **B02c 18/00**

[58] **Field of Search** 241/86, 86.1, 86.4, 95, 241/275, 28, 91, 27, 93, 228, 90, 5; 259/96

[56] **References Cited**

UNITED STATES PATENTS

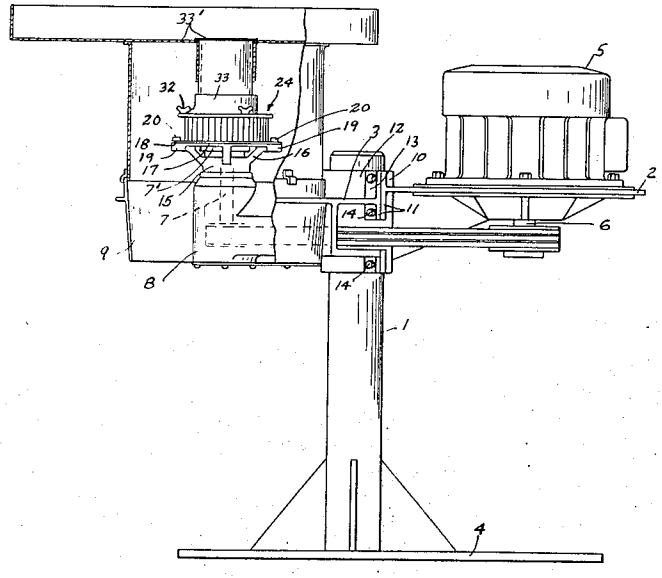
2,874,909	2/1959	Pallmann	241/28
3,196,916	7/1965	Urschel	241/95
3,251,389	5/1966	Urschel et al.	241/5

Primary Examiner—Roy Lake
Assistant Examiner—DeWalden W. Jones

[57] **ABSTRACT**

The invention involves a cutting mill having a cylindrical head provided with a plurality of circumferentially arranged cutting edges and an impeller which is rotatable at a relatively high rate of speed and provided with blades which are so designed and constructed that the noise of the mill during its operation is appreciably reduced to an acceptable limit which will not impair the hearing of an operator.

18 Claims, 12 Drawing Figures



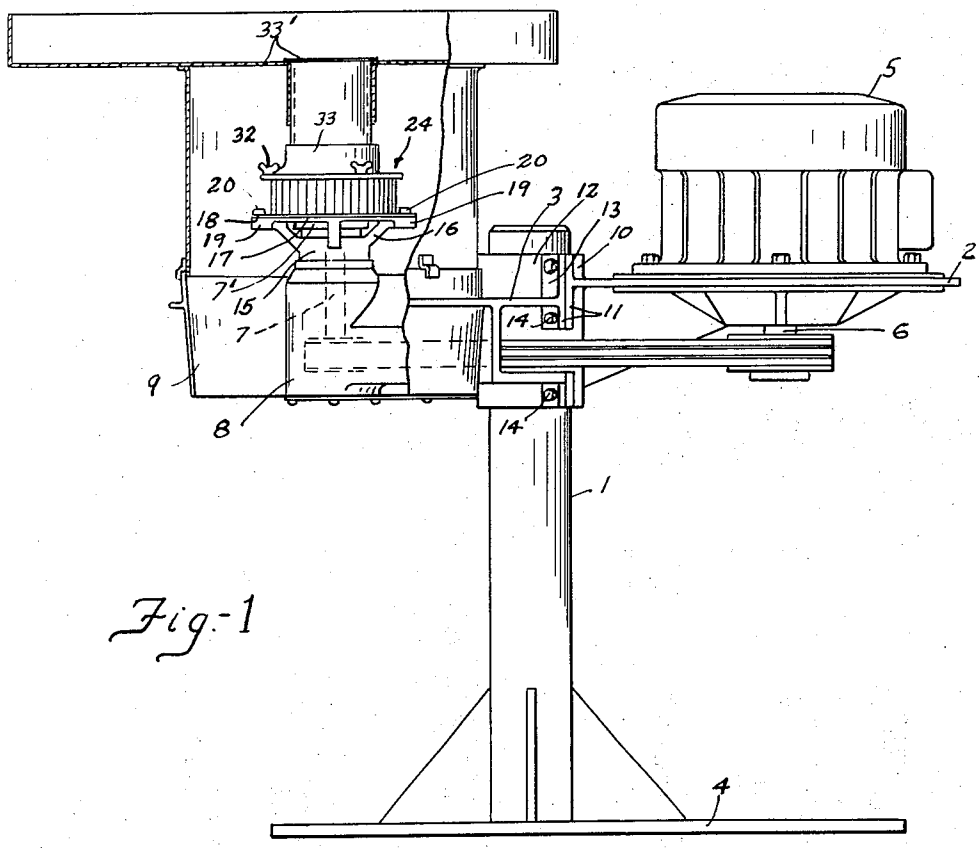

33'
33
32
24
20
19
18
17
7'
15
7
9
8
16
3
12
13
10
14
11
5
2
6
1
4

Fig.-1

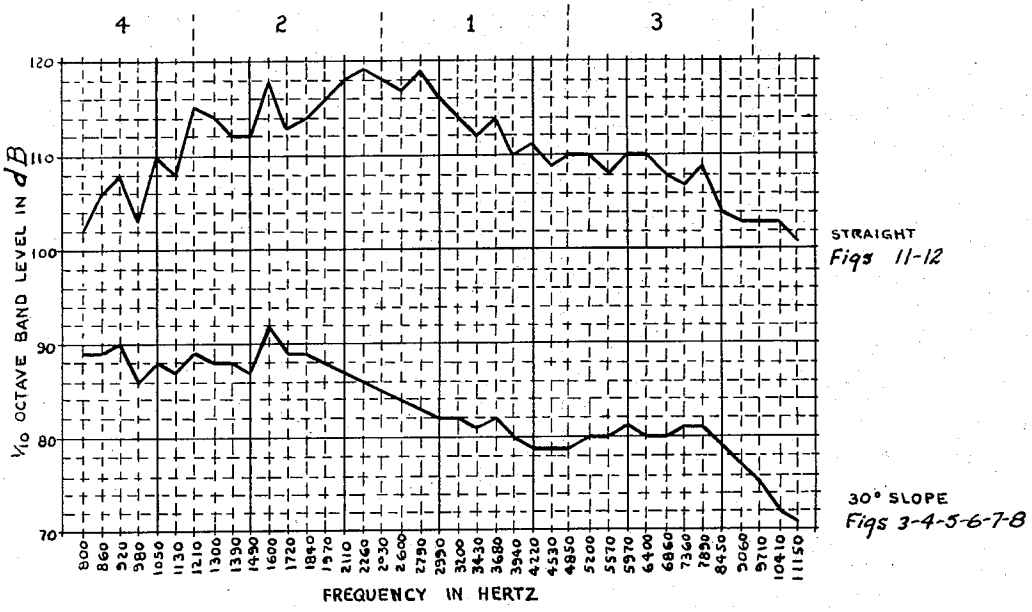

4
2
1
3
120
110
100
90
80
70
1/10 OCTAVE BAND LEVEL IN dB
800
860
920
980
1050
1130
1210
1300
1390
1490
1600
1720
1840
1970
2110
2260
2430
2600
2790
2990
3200
3430
3680
3940
4220
4530
4850
5200
5570
5970
6400
6860
7360
7890
8450
9060
9710
10410
11150
FREQUENCY IN HERTZ
STRAIGHT
Figs 11-12
30° SLOPE
Figs 3-4-5-6-7-8

Fig.-2

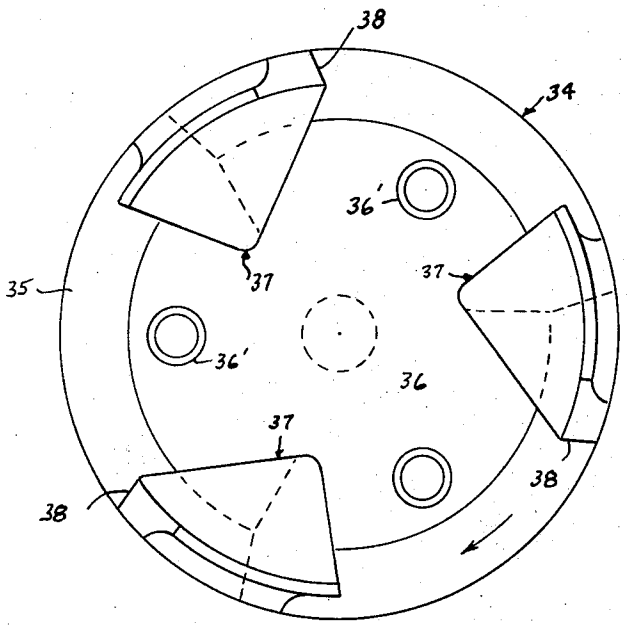


Fig.-3

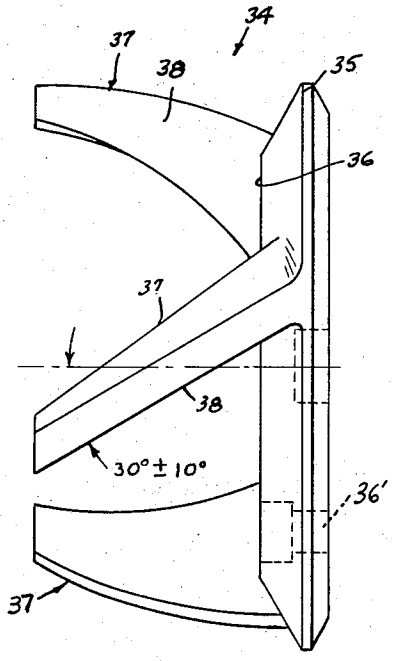


Fig.-4

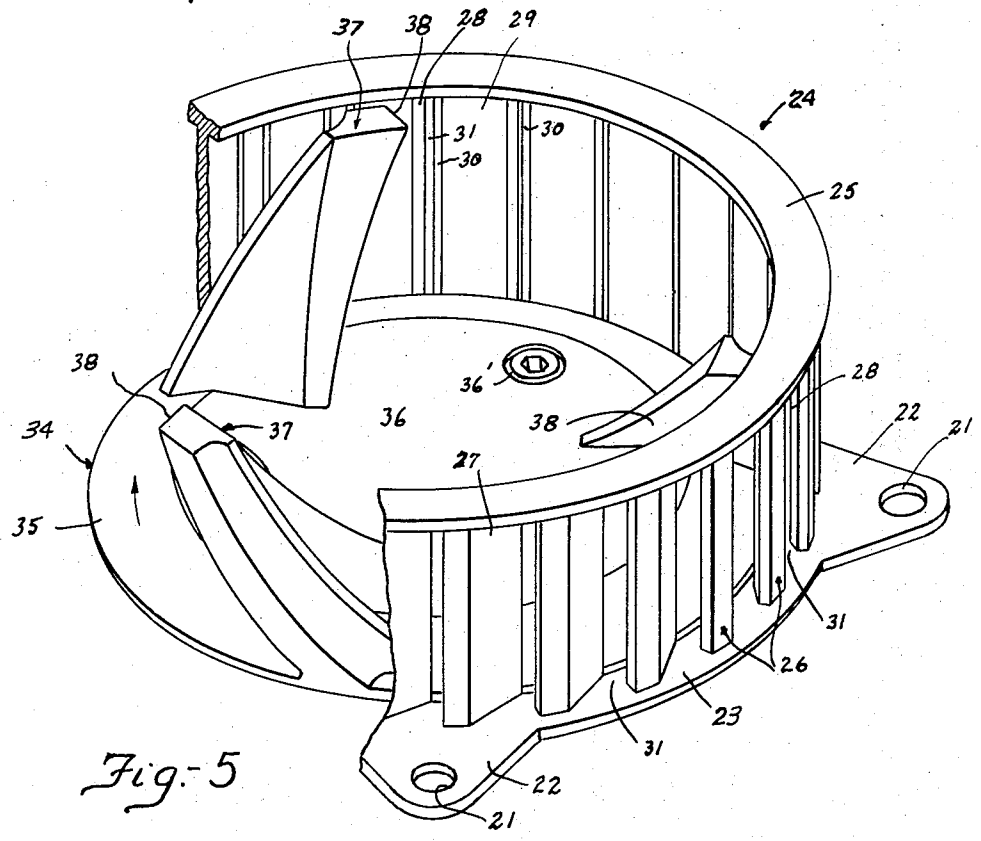


Fig.-5

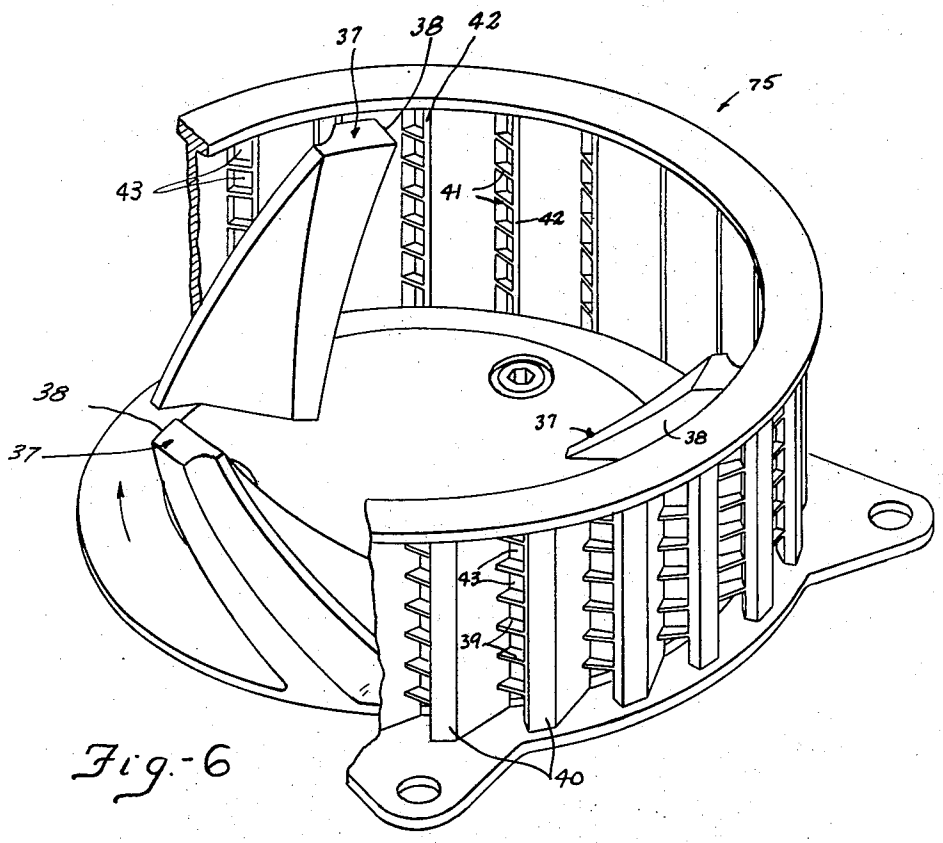


Fig.-6

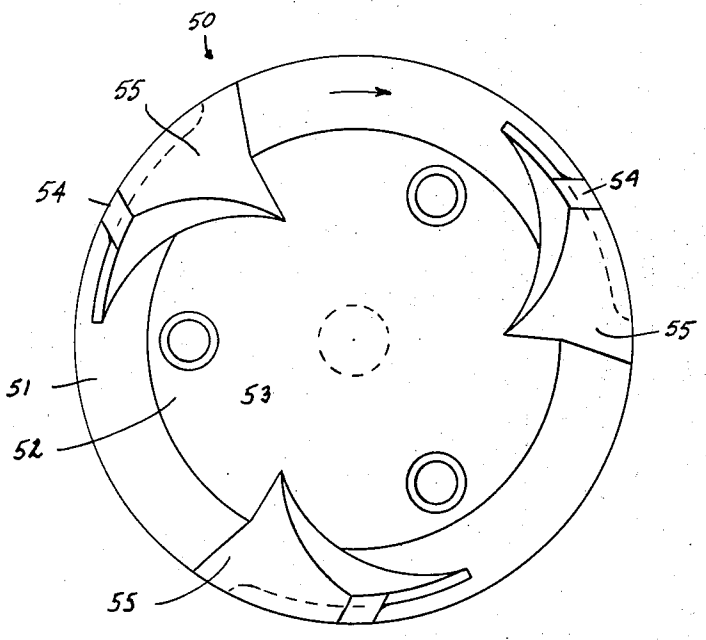


Fig.-7

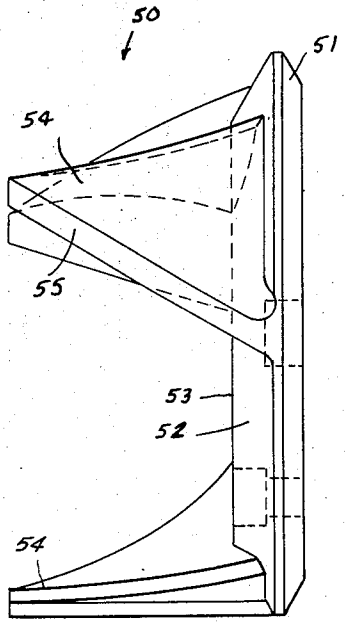


Fig.-8

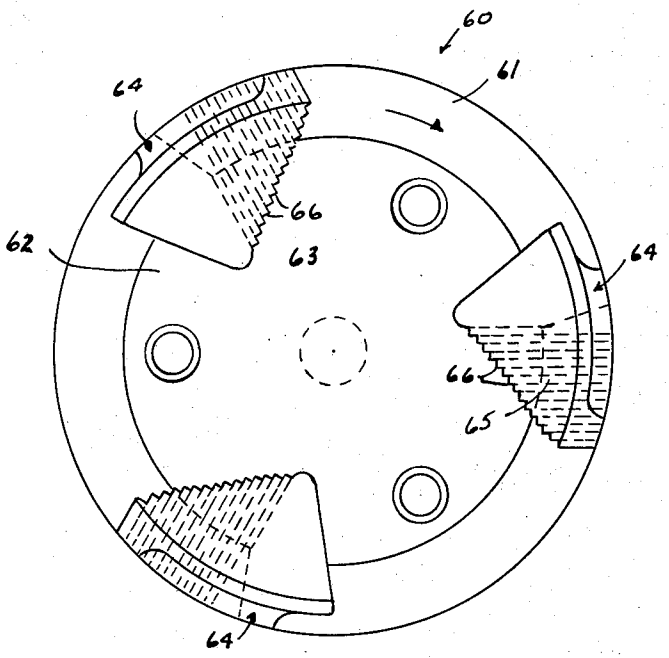


Fig.-9

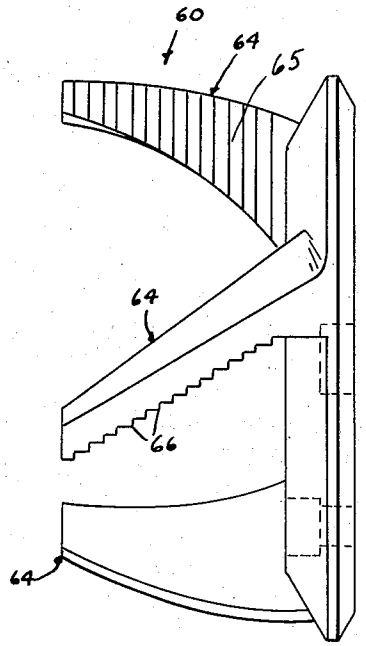


Fig.-10

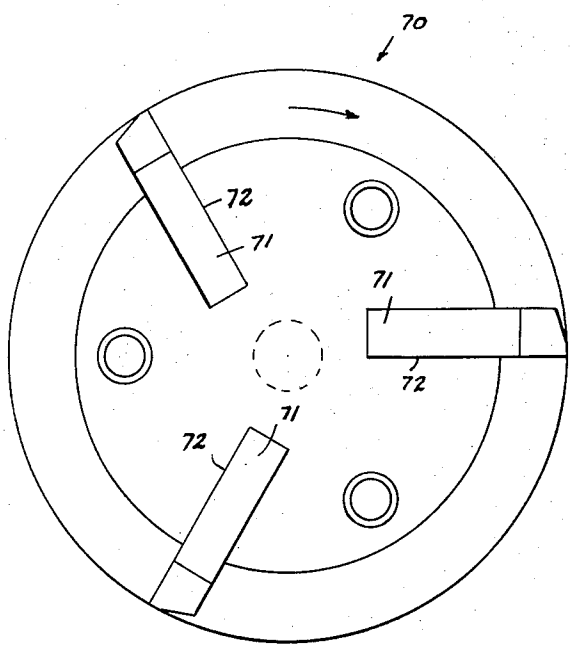


Fig.-11

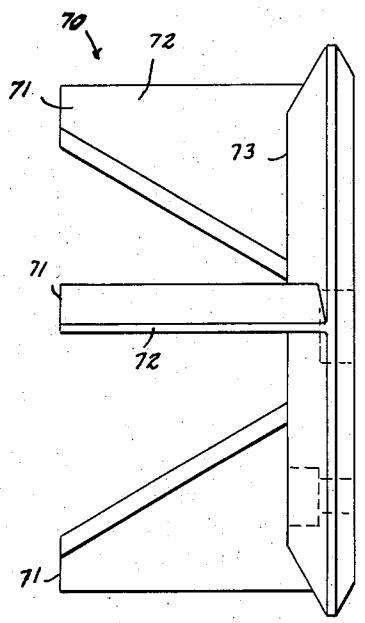


Fig.-12

MACHINE FOR REDUCING THE SOUND LEVEL OF ITS OPERATION

The invention relates generally to a means for conditioning or reducing the size of a product and more particularly is directed to a cutting mill in which the noise produced by its operation is appreciably reduced to a level or range so that the hearing of an operator or other individuals nearby will not be damaged or impaired.

In order to obtain a better understanding of the subject invention, attention is directed to the fact that pressure made by sound is measured in decibels and is symbolized as dB and the frequency of sound is measured in Hersts which signifies cycles per second. It measuring sound, a meter may be utilized to measure the dB over a range of frequency spectrum to which the ears are most sensitive and most likely to receive damage and this spectrum is known as the "A" weighting.

Attention is also directed to the fact that the Occupational Safety and Health Act of 1970 of the United States has established a rule that a piece of machinery or equipment operating in the vicinity of an operator or person shall have a noise level no greater than 90 decibels. Some machinery, for example, the cutting mill described and claimed in my U.S. Pat. No. 3,251,389 produces relatively troublesome sound levels ranging as high as 118–120 decibels and since this range is in excess of that conducive to good operating conditions or that prescribed in the Act, the primary objective of the subject invention is to provide a machine in which the sound of its operation is reduced to a level which is not destructive to the human ear.

In the cutting mill embodying the subject invention, the impeller when revolving in a cutting head cuts the air and it produces pressure pulses at a definite frequency depending on the number of vertical posts or circumferentially spaced portions providing knives or cutting edges, the number of blades provided on the impeller, and the speed of the impeller. For example, one form of a conventional impeller with three blades operating in a cutting head having 24 knives or cutting edges and with the impeller operating at 3,600 R.P.M., the frequency produced will be $3 \times 24 \times 3{,}600 = 259{,}200$ cycles per minute or 4,320 Hersts. Most damage to the human ear is caused by frequency in the general range of 1,000 to 5,000 Hersts, and the aforesaid frequency of 4,320 Hersts is obviously within this range.

With the foregoing in mind, it was determined that if the frequency could be increased, both the point of normal human hearing which ends up at 15,000 Hersts and the sound produced by the machine or mill would not be objectionable. With this objective in mind, provision has been made whereby to appreciably reduce the noise level in the various improved structures disclosed herein.

Accordingly, a significant object is to provide an impeller having blades, which embody improved principles of design and construction which serve the dual purpose of efficiently directing a product against the knives of a cutting head and in reducing the sound of the machine during its operation to a normal level or range which will not damage one's ability to hear.

More specifically, an object of the invention is to provide an impeller in which the leading impact areas,

faces or portions of the blades of the impeller are inclined forwardly at an angle in the neighborhood of 30° with reference to the knives or cutting edges of a cutting head. Otherwise expressed, the impeller includes a base and the leading faces of the impeller are inclined at an angle in the neighborhood of 60°, with reference to the base, in the direction of rotation. The leading faces may also be disposed at different angles and in various shapes, for example, they may be inclined in a reverse direction and be provided with steps, as will be described subsequently.

In the drawings:

FIG. **1** is an elevational view of a machine embodying the subject invention;

FIG. **2** is a graph or chart exemplyfying technical attributes of the invention as compared to results achieved by a conventional structure;

FIGS. **3** and **4** are top and side views of an impeller which may be utilized with either of the cutter heads illustrated in FIGS. **5** and **6** of the machine;

FIG. **5** is a pictorial view showing a structure comprising a cutter head of one style or form and an impeller rotatably mounted therein; with a portion of the head being broken away to illustrate details of the impeller;

FIG. **6** is a pictorial view, similar to FIG. **5**, showing an impeller operable in a cutter head of a style or form different than that depicted in FIG. **5**;

FIGS. **7** and **8** are top and side views of a different style or form of impeller which may be utilized with either of the cutter heads shown in FIGS. **5** and **6**;

FIGS. **9** and **10** are top and side views of another modified form of an impeller which may be utilized in conjunction with either of the cutter heads shown in FIGS. **5** and **6**; and

FIGS. **11** and **12** are top and side views of a conventional impeller which may be utilized in conjunction with either of the cutter heads shown in FIGS. **5** and **6** and others, and are presented for comparative purposes with the other impellers depicted in FIGS. **4**, **8** and **10** and data set forth in the graph of FIG. **2**.

Referring first to FIG. **1** of the drawing there is shown a pillar **1** to which lateral supports **2** and **3** are connected. The pillar may be carried by a base **4** to facilitate placement of the machine at desired location. A motor **5** is mounted on the support **2** and provided with a depending vertical drive shaft **6** which is preferably operatively connected to a vertical driven shaft **7** through a plurality of V-belts and pulleys. The driven shaft is journalled in a bearing structure of the support **3** and its upper end carries a plate **7'** to which an impeller may be detachably connected. A housing **8** is provided within which pulleys on the driven shaft and portions of the belts are concealed for protection against downward flow of the resultant shaved or comminuted product through a tapered cylindrical guide **9** disposed about the housing.

The supports **2** and **3** above referred to, may be designed and constructed as desired but as shown the support **2** is provided with a semi-cylindrical portion **10** which receives the pillar and is also provided with a pair of flanges **11**. The support **3** is similarly provided with a semi-cylindrical receiving portion **12** and a pair of flanges **13**. It will be observed that only one of each of the pairs of flanges **11** and **13** are shown in FIG. **1**. Bolts **14** may be extended through holes in the flanges for detachably clamping the supports in any desired ro-

tative and/or elevated position on the pillar for stability and convenience in operation.

The support **3** is provided with a spider-like mounting having a tubular portion **15** through which the driven shaft **7** extends and with a plurality of inclined arms **16,** which are joined by an annular rest **17** having a horizontal planar seat **18.** The rest is provided with radially extending lugs **19** which are aligned with the arms **16** and have upper planar surfaces which constitute lateral continuations of the seat. These lugs are provided with openings through which fastening means preferably in the form of screws or bolts **20** may be extended as well as through apertures **21** provided therefor in ears **22** of a lower end ring **23** of a cutter assembly or head generally designated **24** as depicted in FIGS. **1** and **5** for detachably and firmly anchoring the same upon the rest **17** of the supporting structure. This same set-up may be employed for supporting different forms of cutter heads and impellers, such as, for example, the cutter head and impeller disclosed in FIGS. **6** and **7,** as will be described more in detail subsequently.

The cutter head **24** shown has a diameter in the neighborhood of 6 inches and includes the lower end ring **23,** above referred to, an upper end ring **25** and a plurality of circumferentially equally spaced corresponding axially extending posts generally designated **26** which are interposed between the rings. The number of posts may be varied, for example, the number shown totals 24 but some cutter heads now in use number 20 and 28. More specifically, each of the posts, among other things, is provided with a front planar side surface **27,** a rear planar side surface **28** and an inner outset planar surface **29,** which affords relief or clearance for an axially extending cutting edge or area **30** disposed in parallel relation to the longitudinal axis of the head. The rear side surfaces **28** of the posts in combination with the front side surfaces **27** of adjacent posts define divergent or tapered discharge openings **31** for the conditioned or comminuted product. The upper end ring **25** may be provided with apertures through which fastening means **32** may be extended for attaching a fitting **33** thereto for cooperation with a hopper **33'** as depicted in FIG. **1.**

An impeller generally designated **34** as shown in FIGS. **3, 4** and **5** may be utilized in the cutter head **24** and comprises a base having an outer annular beveled portion **35** and a central planar portion **36** provided with countersunk openings **36'** through which fastening means may be extended into the plate **7'** on the driven shaft **7** for detachably connecting the impeller thereto for operation at a desired speed, for example, within a range of between 500 and 9,500 R.P.M. The fastening means are preferably inset as depicted in FIG. **5** in order to prevent interference with the flow of a product relative to the impeller. This impeller has an overall height in the neighborhood of 3 inches and is preferably provided with a plurality of three upstanding blades or abutment means generally designated **37** having lower extremities which merge with and are integral with the annular and central portions of the base, to impart stability to the blades and provide outward flow of the product. These blades may be designed and constructed in various ways, but each is preferably tapered and generally triangular in cross-section and provided with a planar leading face or impact surface **38** which may be described as being preferably inclined forwardly in the direction that the impeller rotates or at an angle in the neighborhood of 30° with reference to the cutting edges or areas **30** of the cutter head. The outermost surfaces or edges of the blades of the impeller are preferably spaced a predetermined radial distance from the cutting edges **30** and shaped to provide clearance so as to obtain a shaving or shearing cut without mashing, crushing or grinding of the product. A clearance of .003 inch has proven satisfactory under most conditions of operation. It is desirable that the clearance be the smallest running clearance so as to prevent the product from rolling under the edges of the blades which would tend to crush the product and defeat the purpose of the mill. It may also be stated that the leading surfaces **38** intersect the lines of the cutting edges so that when the impeller is rotated, for example, in a clockwise direction as indicated by the arrows the upper portions of the leading surfaces, when viewed in FIG. **5,** will cross the upper portions of the cutting edges **30** in advance of that of the lower portions of the leading surfaces and in so doing the leading surfaces will gradually intersect the cutting edges and this relationship, at least in some measure, serves to reduce the noise factor as compared to certain conventional impeller structures now in commercial use such as, for example, the type of impeller exemplified in FIGS. **11** and **12** of the drawings.

In view of the above, when an impeller embodying the invention revolves in a cutter head, it cuts the air and produces pressure pulses at a definite frequency depending on the factors above referred to. Attention is directed to the fact that the leading surfaces may be shaped as desired but as shown they preferably are of a generally triangular shape so that the upper leading surface or the upper extremity of each blade is narrower at the top of the blade than its lower extremity. The particular blades shown serve to efficiently direct the product outwardly toward the cutting edges of the head. It should also be observed that the leading surfaces **38** are preferably disposed in substantially radial planes and that portions of these surfaces extend downwardly and merge into the beveled and central portions of the impeller base.

It is to be understood that the 30° angle of the leading surfaces **38** has proven successful but any angle within a range of between 20° and 40°, as shown in FIG. **4,** has also proven satisfactory for reducing the noise level within acceptable limits. From the standpoint of reducing noise, it would be desirable to increase the slope beyond 30°, but when doing this, operation on the product being reduced in size is degraded. To make the angle less than 30° increases the noise beyond acceptable limits.

Of further significance is the fact that the inclined leading surfaces **38** also serve to substantially hold down or retain the introduced product in the cutter head so that it is efficiently presented by centrifical force against the cutting edges **30** for comminution and subsequent flow outwardly through the tapered discharge openings **31.**

Attention is particularly directed to the important fact that the inclined leading surfaces **38** or blades of the impeller may also be defined as being inclined forwardly at an angle in the neighborhood of 60° with reference to the base of the impeller structure, as distinguished from defining the leading surfaces as being inclined forwardly with respect to the cutting edges **30.** This 60° of angle is preferable for many applications

but the angle may be within a range of between 50° and 70° depending on certain or all of the factors above referred to.

As set forth above, the impeller **34** may also be utilized in conjunction with a modified form of cutter head **75**, which is illustrated in FIG. **6** of the drawing. This cutter head substantially corresponds to the cutter head **24**, above referred to, and includes additional structure, such as additional circumferentially spaced portions or members **39** which are joined to posts **40** and provided with inner straight cutting edges **41** disposed in contiguous relation with axially extending cutting edges or areas **42** provided on the posts. It will be observed that the portions **39** are axially spaced apart transversely in rows and that their cutting edges **41** are angularly disposed in advance and/or to the rear of the cutting edges **42** provided on the posts. The portions **39** not only provide additional cutting edges to promote product comminution but also serve to reinforce the posts and provide rows of axially spaced discharged openings or outlets **43** for the comminuted product.

Referring now to FIGS. **7** and **8** of the drawings there is disclosed a modified form of an impeller generally designated **50** which may be utilized for operation in either of the cutter heads **24** and **75**. The impeller **50** includes a base having an annular beveled portion **51** and a central portion **52**, the latter of which is attachable to a plate, such as **7'**, in the manner as described above. The central portion **51** has an upper substantially planar surface **53**. This modified impeller is preferably provided with circumferentially spaced corresponding blades **54** which are preferably generally triangular in cross-section and respectively provided with leading faces or surfaces **55** which are inclined rearwardly at an angle in the neighborhood of 30° with reference to the cutting edges of a cutter head, as distinguished from being inclined forwardly like the leading surfaces **38** of the blades **37** as alluded to above. It will be observed that the surfaces **55** are also preferably generally triangular in shape and include portions which are flared in order to assist in directing the product against the cutting edges of a cutter head. The impeller **50** whether utilized in conjunction with either of the cutter heads **24** and **75** serves to appreciably reduce the noise level of the machine or mill within recognized acceptable limits below 90 decibels. When the impeller is considered as a separate entity or component the leading surfaces may be described as being disposed at rearwardly inclined angles of 60° with reference to the base of the impeller and this inclination may be within a range of between 50° and 70°. Otherwise expressed, the angle of inclination may be defined as being disposed at an angle of 30° with respect to a line perpendicular to the base and the same reasoning applies to the blades **37** of the impeller exemplified in FIGS. **3** and **4**.

Attention is directed to the fact that the blades **54** of this modified impeller are so fashioned that they tend to allow the product to raise upwardly to some extent from the base of the impeller during rotation of the latter, as distinguished from holding or the tendency to hold the product down to some extent when the impeller **34** is utilized.

Referring to FIGS. **9** and **10** of the drawings there is illustrated a modified form of an impeller generally designated **60** having a base formed by an annular bevelled portion **61** and a central portion **62** provided with an upper substantially planar surface **63**. This modified form of impeller may be attached to a plate, such as **7'**, for use with either of the heads **34** and **75** and is provided with a plurality of three circumferentially spaced corresponding blades generally designated **64** which are generally triangular in cross-section and provided with leading faces or surfaces **65** which are preferably inclined forwardly at angles in the neighborhood of 30° in the direction of rotation with reference to the cutting edges of either head or if the impeller is considered as a separate component, then the blades may be described as being disposed at an angle of 60° with reference to the base or in the alternative the blades may be defined as being located at a forward inclined angle of 30° with reference to a line perpendicular to said base. It is to be understood, as set forth above, that the blades may be located within the angular ranges described above. Attention is directed to the fact that each of the leading faces or impact surfaces or areas **65** is generally triangular in shape and preferably provided with stepped or serrated surfaces **66** of variable widths for directing a product against the cutting edges of a cutter head for comminution and subsequent flow outwardly therefrom. These stepped or serrated surfaces **66** on the frontal portions of the blades **64** have also proven to be efficient for the purpose of appreciably reducing the noise factor at a level within an acceptable range below the **90** decibel limit.

All of the different forms of impellers described above embody the principles of design and construction or attributes of the subject invention, as distinguished from a conventional form of an impeller, such as the one generally designated **70** as exemplified in FIGS. **11** and **12**. The impeller **70** is characterized by having blades **71** provided with leading faces or surfaces **72** which are perpendicular to an upper planar surface **73** of a base of the impeller, as distinguished from being inclined forwardly or rearwardly from the direction of the impeller's rotation as set forth above. As previously alluded to, impellers more or less corresponding to the impeller **70** have been in commercial use for some time as a component of equipment, such as that disclosed in my U.S. Pat. No. 3,251,389 and this impeller which may also be utilized in either of the cutter heads **24** and **75** is presented solely for the purpose of comparing its structure and adverse noise level with that of the improved impellers **34, 50** and **60** clearly exemplified in the chart of FIG. **2**, as will be described more in detail subsequently.

In support of the above precepts attention is directed to the fact that when any one of the impellers **34, 50** and **60** rotates in a cutting head it cuts the air and produces pressure pulses at a definite frequency depending upon the number of vertical posts in the cutting head, the number of blades in the impeller and the speed of the impeller. For instance, as briefly described above, if a conventional impeller with three blades is rotated in a cutting head having **24** posts and with the impeller operating at 3,600 revolutions per minute, the frequency produced will be $3 \times 24 \times 3{,}600 = 259{,}200$ cycles per minute or 4,320 Hertz. This is a result obtained by utilizing the conventional impeller depicted in FIGS. **11** and **12** of the drawing. Most damage to the human hearing is caused by frequencies in the general range of 1,000 to 5,000 Hertz. The frequency of 4,320 Hertz produced by the machine utilizing this conventional impeller is within this range. It was determined

that if the frequency could be increased to a point beyond human hearing, which ends off at about 15,000 Hertz, then the sound produced by the machine would not be objectionable. If the leading face of the impeller blades could be made in steps, then the number of pulses would be increased in accord with the number of steps on the face of the impeller. Each of the blades of the impeller shown in FIGS. **9** and **10** is provided with 16 steps or serrations. In theory this should produce a frequency of $3 \times 24 \times 16 \times 3{,}600$ divided by 60 or 69,120 Hertz. If an impeller were made having a straight face to the blades but with this face sloped off at a considerable angle from the axis of the impeller, then in theory the face of this impeller would have an infinite number of steps and would produce an infinitely high frequency. Such impellers designated **34, 50** and **60** are respectively shown in FIGS. **4** and **5, 7** and **8,** and **9** and **10.** Actual tests show that such impellers with either a large number of steps or with a straight slope produce a sound level ranging between 87 and 89 dB. This is acceptable by the standards of the 1970 Occupational Health and Safety Act.

After is was determined that this theory worked in practice, research was made to ascertain exactly what sound pressures result at various frequencies and the results of this research is shown in the chart of FIG. **2.** The frequencies shown on the chart do not produce exact high peaks of sound at particular frequencies because there are other elements in the machine that produce noise. Other research has proven that as the number of steps, as shown in FIGS. **9** and **10,** are increased above **4,** the peak of greatest noise is at a higher frequency.

The upper part of the chart shown in FIG. **2** is marked off in various areas of frequency in bands, as indicated at **1, 2, 3** and **4**; the lower part in frequencies in Hertz; the left in 1/10 octave band levels in dB; and to the right identification of the impellers. In reports entitled Noise as a Public Health Hazard, a publication of the American Speech and Hearing Association, the frequencies shown in band **1** are presented to be the most damaging to the ear, in band **2** that the frequencies are less damaging, the band number **3** still less damaging, and that those in band number **4** are the least damaging. The chart shows that the impellers having the 30° slope on the face of the blades produces greatly reduced sound levels in the area of band frequencies numbers **1** and **2** which are most damaging to the ear.

Machines and/or impellers embodying the subject invention are presently in commercial use and such use has met the standards of OSHA, the above referred to act.

In view of the foregoing it should be manifest that the subject invention embodies improved principles of design and construction with respect to equipment for comminuting a product in a manner whereby the noise level of the equipment is materially reduced to a level which will not impair the hearing of an operator.

Having thus described my invention, it is obvious that various modifications may be made in same without departing from the spirit of the invention and therefor, I do not wish to be understood as limiting myself to the exact forms, constructions, arrangements and combinations of any of the components herein shown and described.

I claim:

1. A machine of the kind described comprising; an assembly having a plurality of spaced elements substantially forming a cylinder and provided with cutting edges, an impeller mounted for rotation in said cylinder and having circumferentially spaced abutments provided with surfaces which are inclined in the direction of rotation for rotating and forcing a product introduced into the cylinder against said edges for cutting the product into pieces and flow of the latter outwardly through the spaces separating said elements.

2. The machine defined in claim **1,** in which said assembly includes a pair of annular rings and said elements are in the form of circumferentially spaced axially extending members having ends which are joined to said rings.

3. The machine defined in claim **1,** in which said elements are in the form of circumferentially spaced axially extending members and radially extending members which are fixedly secured in the spaces separating said first-mentioned members.

4. In combination: a substantially cylindrical cutter head having a plurality of circumferentially spaced axially extending members respectively provided with cutting edges, and an impeller mounted in said cylinder for rotation in one direction provided with circumferentially spaced blades which are respectively provided with impact areas for directing a product against said edges for reducing its size and flow outwardly through the spaces between said members, said impact areas being inclined in the direction of rotation at an angle of substantially 30° with respect to said cutting edges.

5. The combination defined in claim **4,** in which each impact area may be disposed at any angle within a range between 20° and 40°.

6. The combination defined in claim **4,** in which each impact area comprises a plurality of stepped surfaces.

7. The combination defined in claim **4,** in which said blades are of tapered cross-section.

8. The combination defined in claim **4,** in which said members are joined by a plurality of axially spaced circumferentially extending elements which are disposed substantially in the spaces between said members.

9. A machine of the kind described comprising; an assembly having a plurality of spaced elements substantially forming a cylinder and provided with cutting edges, an impeller mounted for rotation in said cylinder and having circumferentially spaced abutments provided with surfaces which are inclined in a direction opposite to that of rotation for rotating and forcing a product introduced into the cylinder against said edges for cutting the product into pieces and flow of the latter outwardly through the spaces separating said elements.

10. In combination: a substantially cylindrical cutter head having a plurality of circumferentially spaced axially extending members respectively provided with cutting edges, and an impeller mounted in said cylinder for rotation in one direction provided with circumferentially spaced blades which are respectively provided with impact areas for directing a product against said edges for reducing its size and flow outwardly through the spaces between said members, said impact areas being inclined in a direction opposite to that of rotation at an angle of substantially 30° with respect to said cutting edges.

11. A machine of the kind described comprising: an assembly having a plurality of spaced elements substantially forming a cylinder and provided with cutting edges, an impeller mounted for rotation in said cylinder and having circumferentially spaced abutments provided with surfaces for forcing a product introduced into the cylinder against said edges for cutting the product into pieces and flow of the latter outwardly through the spaces separating said elements, and said surfaces being inclined in a direction sufficient to reduce the operating noise level of the machine below 90 decibels when said impeller is rotated within a range of between 500 and 9,500 R.P.M.

12. A machine of the kind described comprising: an assembly having a plurality of spaced elements substantially forming a cylinder and provided with cutting edges, an impeller mounted for rotation in said cylinder and having circumferentially spaced abutments for forcing a product introduced into the cylinder against said edges for cutting the product into pieces and flow of the latter outwardly through the spaces separating said elements, and said abutments being inclined in a direction sufficient to reduce the operating noise level of the machine below 90 decibels when said impeller is rotated at a predetermined speed.

13. In combination: a cutter head having a cylindrical wall provided with openings and cutting edges, an impeller arranged in said head for rotation in one direction and having an annular base provided with a plurality of circumferentially spaced abutments extending outwardly from one side thereof, and said abutments being respectively provided with surfaces which are inclined in the direction of rotation at an angle in the neighborhood of 60° for directing a product against said edges for reducing its size and flow through said openings.

14. In Combination: a cutter head having a cylindrical wall provided with openings and cutting edges, an impeller disposed in said head for rotation in one direction and having an annular base provided with a plurality of circumferentially spaced abutments extending upwardly from one side thereof, and said abutments being respectively provided with surfaces which are inclined in the direction of rotation at an angle of less than 70° for engaging, rotating and directing a product outwardly against said edges for reducing its size and flow through said openings.

15. The combination defined in claim 14, in which said abutments have inner extremities which are integral with said base and also have outer free extremities, and said inner extremities have greater cross-sectional dimensions than said free extremities.

16. The combination defined in claim 14, in which said abutments are substantially triangular in cross-section.

17. The combination defined in claim 14, in which said surfaces are substantially triangular in shape.

18. In combination: a cutter head having a cylindrical wall provided with cutting edges and openings, an impeller mounted in said head, said impeller having a round base of substantially uniform thickness and provided with means whereby said impeller may be connected to means for rotating the impeller, a plurality of circumferentially spaced blades extending from one side of said base, and said blades being provided with surfaces which are sufficiently inclined in a direction relative to said base to reduce the noise level of the impeller below 90 decibels when it is rotated at a predetermined speed to cause a product to be directed against said edges whereby to reduce its size for flow through said openings.

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