

Aug. 3, 1937.

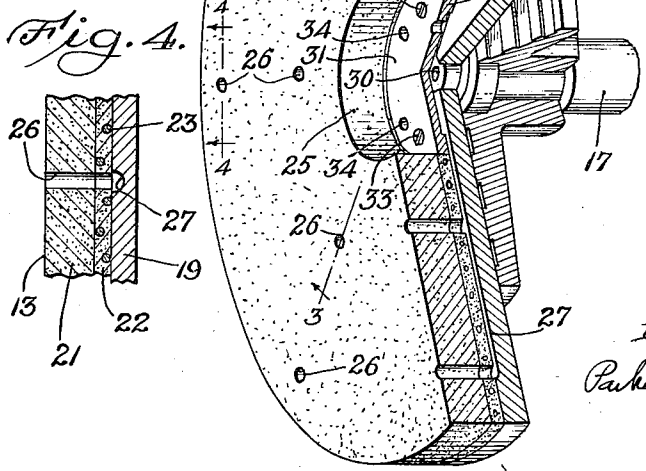
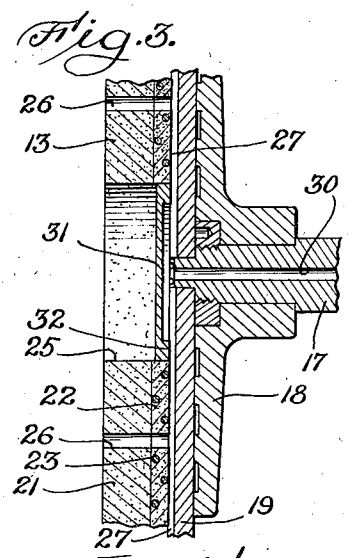
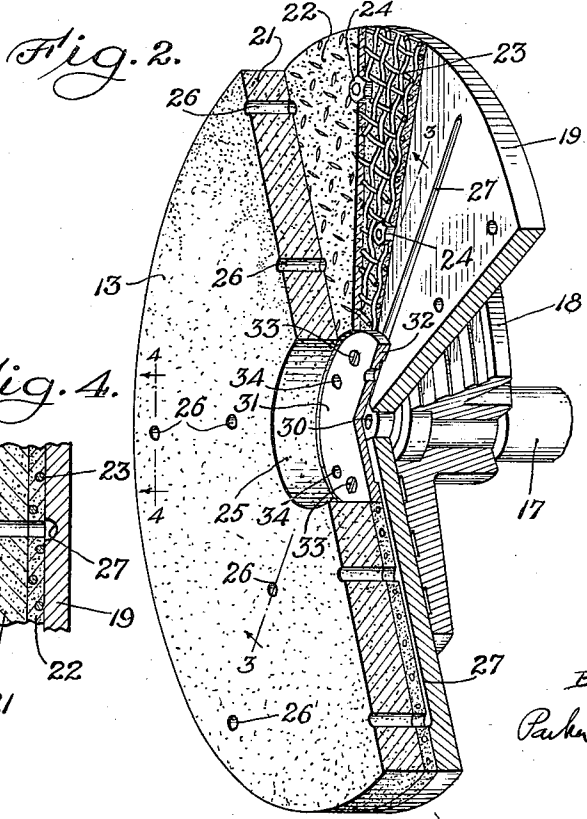
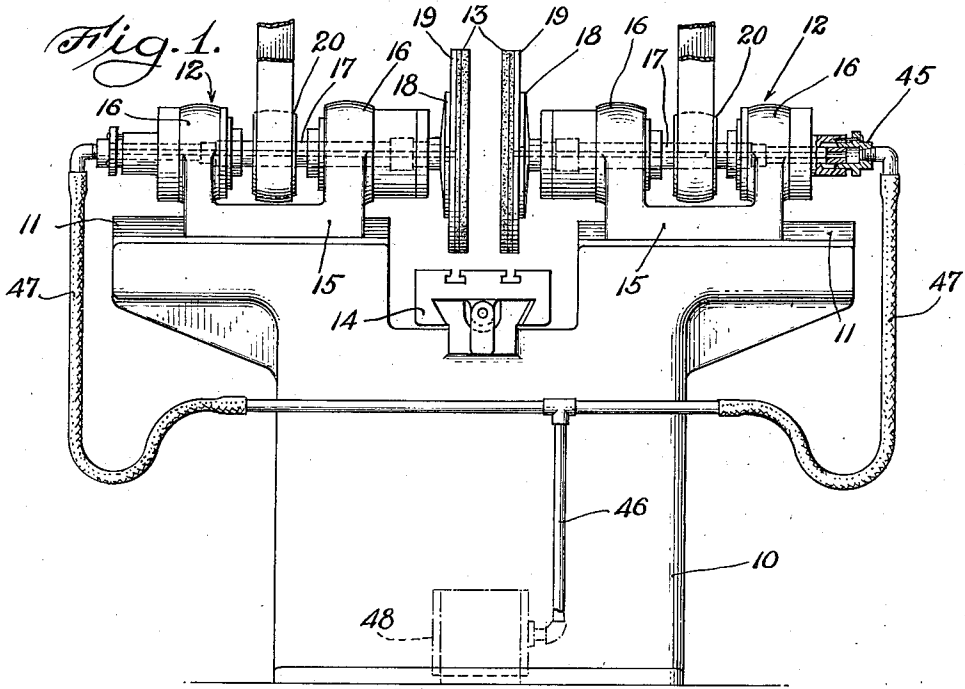
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2,089,040

GRINDING MACHINE AND METHOD OF GRINDING

Filed July 5, 1935

2 Sheets-Sheet 1



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Fig. 5.

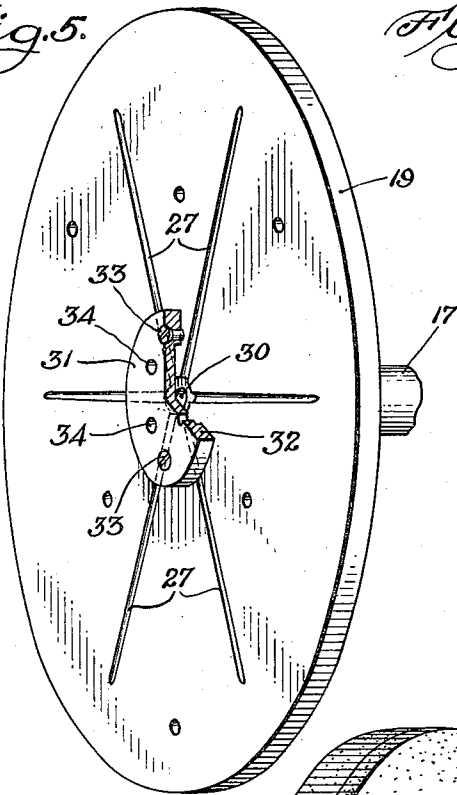


Fig. 6.

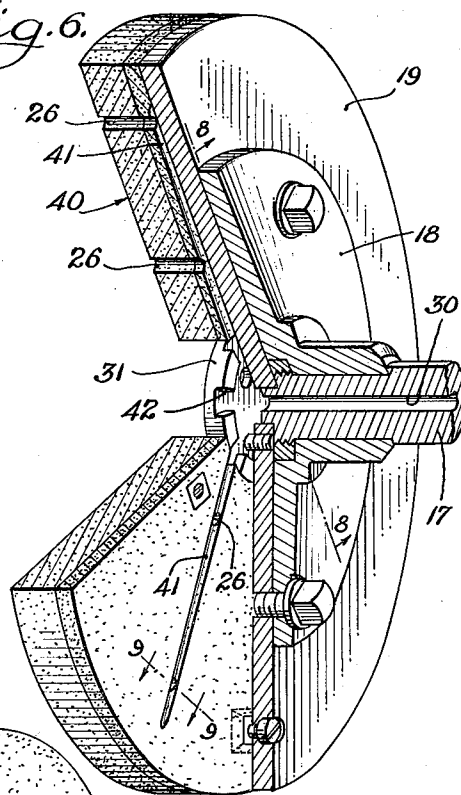


Fig. 7.

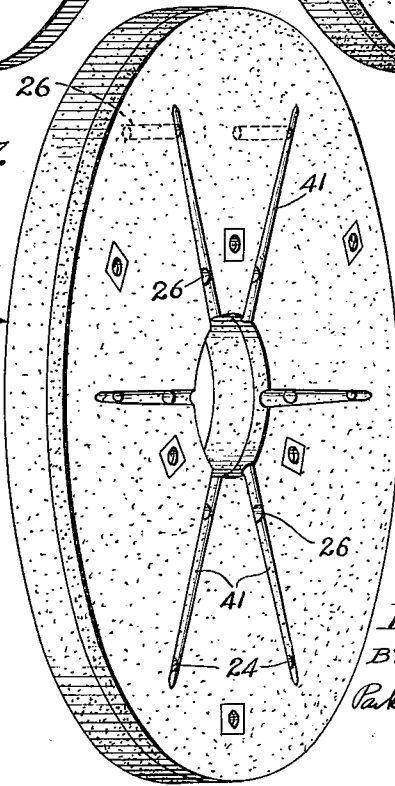


Fig. 8.

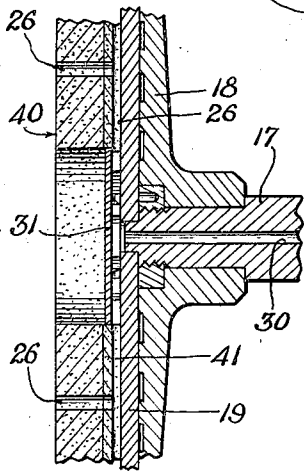
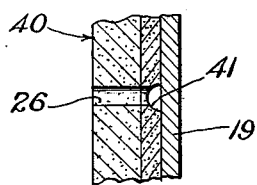


Fig. 9.



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UNITED STATES PATENT OFFICE

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GRINDING MACHINE AND METHOD OF GRINDING

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13 Claims. (Cl. 51—111)

The invention relates generally to grinding machines and more particularly to a grinding machine employing a grinding disk adapted to grind articles on the face thereof.

5 In grinding operations, it is desirable to remove stock from the article being ground as fast as possible in order to keep the cost of the operation down. However, when stock is removed at a high rate, the article tends to become heated. With the high rates attained in the present state of the art, such heating tends to reach such an extent that it is detrimental to the article being ground. Cooling of the article by providing a flow of coolant across the face of the grinding disk has been employed. But even this has proved insufficient in many instances, chiefly because of the fact that the coolant is incapable of reaching in sufficient quantity the surface being ground where the heat is generated. The coolant may be liberally supplied, but the contact of the article being ground with the grinding face sweeps the bulk of the coolant aside. Thus, the surface being ground comes in contact with very little, if any, coolant during the entire operation.

10 The general object of the invention is therefore to supply coolant to a grinding disk in such a manner that it may come in contact with the surface being ground in adequate quantity during the grinding operation.

15 Another object is to provide a grinding machine constructed so that coolant may be forced through the grinding disk to the grinding face thereof to cool surfaces being ground thereon.

20 A further object is to provide a grinding machine having a grinding disk constructed to permit the flow of coolant therethrough, and a means for supporting and rotating the disk constructed to cooperate with the disk in supplying coolant thereto whereby the rotation of said means and the disk induces sufficient pressure on the coolant to effectively force it out between the surface being ground and the grinding disk.

25 Another object resides in providing an improved method of grinding.

30 Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

35 Figure 1 is an elevational view of a grinding machine embodying the features of the invention.

40 Figure 2 is an enlarged fragmentary perspective view, partially in section, of one of the grinding wheel structures of the machine shown in Fig. 1.

45 Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2.

50 Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 2.

55 Fig. 5 is a perspective view of the disk supporting means shown in Fig. 2.

Fig. 6 is a fragmentary perspective view, partially in section, of a modified form of grinding wheel structure.

Fig. 7 is a perspective view of the rear face of the grinding disk shown in Fig. 6.

Fig. 8 is a fragmentary sectional view taken on the line 8—8 of Fig. 6.

Fig. 9 is a fragmentary sectional view taken on the line 9—9 of Fig. 6.

A grinding machine embodying the features of the invention comprises generally a grinding disk constructed to permit the flow of fluid coolant therethrough from the rear face of the grinding disk to its grinding face, thus providing a construction whereby fluid may be conducted directly to the surface being ground to carry away the heat therefrom as it is generated. Preferably fluid is supplied to the disk by passages cooperatively formed by a supporting wheel carrying the disk and the disk itself, said passages extending radially and receiving fluid through the spindle which carries the wheel. Thus, upon rotation of the disk and wheel, the fluid is centrifugally forced outwardly through the passages and then through the disk so that it is supplied under pressure to the surface being ground.

The coolant is preferably a liquid but may be merely air which serves to cool the disk and work piece, and to blow out particles of the disk and work piece removed in the operation of grinding.

The invention is illustrated as embodied in a grinding machine of the double-disk type shown in Fig. 1, in which work may be ground on two parallel surfaces at the same time by passing between a pair of opposed disks. As shown herein, the machine comprises a base 10 providing a pair of spaced ways 11 on which are mounted a pair of spindle heads, indicated generally at 12 and including grinding wheel structures of which grinding disks 13 are a part. The spindle heads are adjustable longitudinally on the ways 11 to vary the space between the disks to accommodate work pieces of different size. Below the disks 13, the machine may be provided with a movable work table 14 for carrying work pieces between the disks.

Each spindle head 12 is illustrated as comprising

ing a head frame 15 having a pair of spaced portions 16 in which a spindle 17 is journaled. The spindle 17 projects beyond the inner of the spaced portions and is provided at its inner end with a collar 18 to support a wheel 19. The latter is adapted to have secured thereto the grinding disk 13 in a usual manner. The spindle 17 may be driven by a pulley 20 mounted thereon between the spaced portions 16.

In the present instance, the disk illustrated comprises two layers, the front layer, indicated at 21, being made of moulded abrasive material, while the rear layer, indicated at 22, is made of moulded material having embedded therein a wire reinforcing mesh 23 and a plurality of nuts 24 adapted to receive bolts extending through the supporting wheel 19 to secure the disk rigidly thereto. The grinding disk has the usual annular shape to provide a relatively large aperture 25 at its center.

The chief feature of the invention is to construct the disk 13 so that fluid coolant may be conducted therethrough from the rear face to the grinding face. Thus, the coolant may be led into direct contact with the surface on the work piece being ground to carry off the heat as it is generated. To this end, the disk is provided with a plurality of relatively small apertures 26 extending through the disk.

At the rear of the disk is means to supply fluid coolant to the apertures 26. Preferably said means comprises passages cooperatively provided by the supporting wheel and the disk, said passages being herein shown as a plurality of grooves 27 closed by the disk and tapered to provide sufficient flow for two apertures 26. The grooves 27 preferably extend radially from the center of the supporting wheel out to the apertures 26 and are closed at their outer ends. Thus, when fluid coolant is supplied to said grooves, it is centrifugally forced outwardly and through the apertures 26 so that it will strike the surface being ground and be forced out between said surface and the grinding face of the disk. It will thus be supplied directly to the surface being ground in adequate quantity to carry off the heat generated.

Preferably the fluid coolant is conducted to the grooves 27 through the spindle 17, the latter having an internal bore 30 for this purpose. At the end of the bore 30 and overlying the inner ends of the grooves 27 is a chamber formed by a cap 31 having a flange 32 abutting the face of the supporting wheel. The flange 32 thus holds the cap proper spaced from the supporting wheel and the end of the spindle so that the coolant may flow out of the bore 30 in the spindle and into the grooves 27. The cap 31 is shaped to fit snugly in the central aperture 25 of the disk, so that the disk and cap completely cover the grooves 27, and is secured to the supporting wheel as by screws 33.

As a further means of supplying coolant to the grinding surface of the disk, the cap 31 may be provided with one or more apertures 34 to permit a flow of coolant over the grinding surface from the central aperture 25.

The grinding disks are preferably enclosed by a hood (not shown) to confine and collect the coolant as it leaves the disks. With oppositely facing disks as shown in Fig. 1, and with liquid coolant, the latter passing out of the aperture 26 which are not covered by the work piece tends to spray against the grinding surface of the opposite disk as well as over the work piece. Thus,

with the coolant confined by a hood the work piece is thoroughly cooled.

In the modified form shown in Figs. 6 to 9, the grinding disk, indicated at 40, is so constructed that the grooves conducting the fluid coolant to the apertures 26 may be in the rear face of the disk, as shown at 41, instead of in the supporting wheel. The latter, however, covers the grooves to provide closed passages. The cap 31 in this form has a plurality of notches 42 cut in its flange to provide communication from the bore 30 of the spindle to the grooves 41.

To supply coolant to the interior of the spindle, a cap 45 is placed over the outer end of the spindle and is held against rotation by the head frame. The cap 45 is connected to a source of coolant supply by a pipe 46 and a connecting tube 47 which is preferably flexible to allow for adjustment of the spindle head. The source of coolant supply may be a pump 48 driven by a separate motor or from the spindle drive.

In operation, the two disks 13 are adjusted to the desired distance apart and a work piece is secured to the work table 14 to be moved between the disks. Upon rotation of the spindle, the fluid coolant supplied to the bore 30 in the spindle from the source 47 is forced by centrifugal force outwardly from the chamber formed by the cap 31, through the grooves 27 in the supporting wheel, and through the apertures 26. The coolant flowing from the apertures 26 passes over the grinding surface of the disk and, as the surface being ground passes over the apertures 26, the coolant comes in direct contact therewith to carry off the heat. Thus, the coolant is supplied directly to the surface being ground. At the same time, coolant is permitted to flow from the apertures 34 in the cap 31 and thence over the grinding surface of the disk. The centrifugal action on the coolant tends to assist or even supplant the pump 48. The flow of coolant also carries off the particles removed from the disk and work piece in the operation of grinding to prevent glazing the disk.

In the modified form shown in Figs. 6 to 9, the chamber formed by the cap 31 is in communication with the grooves 41 by means of the notches 42 cut in the flange of the cap. The grooves 41 are in the rear face of the disk and communicate with the apertures 26 in a similar manner to the grooves 27 in the supporting wheel in the first form.

From the above description, it will be apparent that I have provided a grinding machine in which fluid coolant forced under pressure directly against the surface being ground by conducting the coolant is so arranged that the rotation of the disk centrifugally forces the coolant there-through, the coolant being supplied to said means through a bore in the spindle.

I claim as my invention:

1. In a grinding machine, the combination of a rotatably driven grinding member having a plurality of apertures therethrough, a supporting member for rotating and supporting said grinding member, one of said members having radially extending grooves in its face cooperating with the other member to provide passages extending from the center of rotation to said apertures, said passages being closed at their outer ends, and means to supply fluid to said passages at their inner ends.

2. In a grinding machine, the combination of a rotatably driven grinding disk having a plurality of apertures leading from the rear face

to the grinding face, a supporting wheel for said disk having a plurality of grooves in its front face extending radially to said apertures and closed at their outer ends, said grooves being covered by said disk to provide closed passages, and means to supply fluid to said grooves.

3. In a grinding machine, the combination of a rotatably driven grinding member having a plurality of apertures leading from the rear face to the grinding face, a supporting member for said grinding member, one of said members having a plurality of radially extending grooves closed by the other member to provide a plurality of radially extending passages leading to said apertures, said grooves terminating at said apertures whereby the outer ends of said passages are closed, means providing a chamber in communication with the inner ends of said grooves, and means to supply fluid to said chamber.

4. In a grinding machine, the combination of a grinding disk having a plurality of apertures leading from the rear face to the grinding face thereof, a supporting wheel for said disk, said disk having a plurality of grooves in its rear face leading from the center to said apertures and closed by said supporting wheel, and means for supplying fluid to the inner ends of said grooves.

5. A grinding machine comprising, in combination, a grinding member having a plurality of apertures therethrough, a supporting member having said grinding member secured to its face, one of said members having radial grooves in its abutting face which are closed by the other member to provide passages extending from the center to said apertures, a spindle for driving said supporting member, said spindle being hollow with its interior communicating with said passages, and means to supply fluid to the interior of said spindle.

6. A grinding machine comprising, in combination, a grinding member of disk form having a plurality of apertures leading from the rear face to the grinding face thereof, a hollow spindle, a supporting member mounted on one end of said spindle for supporting said grinding member with one of said members having grooves in its face closed by the other member to form passages providing communication from the interior of said spindle to said apertures, means for supplying fluid to the interior of said spindle at the other end thereof, and means for driving said spindle and positioned intermediate the ends thereof.

7. A grinding machine comprising, in combination, a grinding disk having a relatively large aperture at its center and a plurality of relatively small apertures spaced from the center, a supporting wheel having said disk secured to one face thereof and cooperating with said disk to provide a plurality of passages leading from said central aperture to said small apertures, a hollow spindle having said wheel mounted on one end thereof, a cap mounted in said central aperture and shaped to provide a chamber communicating with said passages and the interior of said spindle, and means to supply fluid to the interior of said spindle.

8. A grinding machine comprising, in combination, an annular grinding disk having a plurality of apertures therethrough at points spaced

from its center, a supporting wheel for said disk cooperating therewith to provide a plurality of passages extending from the interior of said annulus to said apertures, a hollow spindle having the supporting wheel thereon, means for supplying fluid to the interior of said spindle, and means within said annulus providing communication between said passages and the interior of said spindle and having a plurality of holes opening toward the grinding face of said disk whereby fluid may flow over the grinding face of said disk from the interior of said annulus and from said apertures.

9. A grinding machine comprising, in combination, a grinding disk having a relatively large central aperture and a plurality of relatively small eccentrically located apertures, a hollow spindle, a supporting wheel for the disk mounted on one end of said spindle and cooperating with said disk to provide a plurality of passages leading from said central aperture to said eccentric apertures, a cap positioned within said central aperture and having a flange abutting the face of the supporting wheel to provide a chamber communicating with the interior of said spindle and with said passages, and means to supply fluid to the interior of said spindle.

10. A grinding machine comprising, in combination, a grinding disk having a relatively large central aperture and a plurality of relatively small eccentrically located apertures with radial grooves in the rear face extending from said central aperture to said eccentric apertures, a hollow spindle, a supporting wheel mounted on one end of said spindle and having the disk secured to the face thereof thereby covering said grooves, a cap mounted within said central aperture and having a flange abutting the face of the supporting wheel to provide a chamber in communication with the interior of said spindle, said flange being radially notched to provide communication between said chamber and said grooves, and means to supply fluid to the interior of said spindle.

11. In a grinding machine, the combination of a rotatable grinding member having a plurality of apertures leading from the rear face to the grinding face thereof, a supporting member for said grinding member, one of said members having radial grooves providing in conjunction with the other member a plurality of radial passages extending from adjacent the center of rotation to said apertures, and means for supplying fluid to said passages adjacent the center of rotation whereby rotation of said members will centrifugally force the fluid outwardly through said passages and said apertures.

12. A supporting wheel of the character described having a plurality of grooves in its face extending from the center of the wheel radially and terminating short of the periphery of the wheel and adapted to be closed to provide fluid conducting passages leading to a point adjacent the periphery thereof.

13. A grinding disk having a plurality of eccentrically located apertures leading from its rear face to its grinding face and a plurality of radial grooves in its rear face leading to said apertures and adapted to be covered by a supporting wheel to provide passages for fluid.