United States Patent [19]

Sommer

[11] **3,903,655**

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[54] **GRINDING MACHINE WITH RESILIENT CONTROL WHEEL**

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[73] Assignee: **American Gage & Machine Company**, Elgin, Ill.

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[52] **U.S. Cl.** ..... **51/103 R**

[51] **Int. Cl.²** **B24B 5/30**

[58] **Field of Search** ..... 51/103 R, 103 C, 103 WH, 51/103 TF, 238 GG, 259, 289 R; 74/214-216; 29/132

[56] **References Cited**

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[57] **ABSTRACT**

The disclosed grinding machine comprises a grinding wheel which is driven at a relatively high surface speed, a pair of centers or other means for rotatably supporting a work piece which is to be ground, and a control wheel which frictionally engages the work piece and is adapted to rotate the work piece at a relatively low surface speed. The control wheel is driven by a motor or other means, at a low surface speed. In accordance with the present invention, the control wheel has a generally cylindrical core portion which is made of a relatively soft resilient material, such as rubber or the like. The control wheel has a generally cylindrical ring shaped peripheral portion which is securely mounted around the core portion and is made of a substantially harder resilient material, such as rubber or the like. The ring shaped peripheral portion is in frictional driving engagement with the work piece. The provision of the soft resilient core portion makes it possible for the control wheel to adapt itself to variations in the work piece, so that the control wheel will be in full driving engagement with the work piece, even if the work piece is out of round or is tapered. Thus, the work piece is fully controlled during the grinding operation, so that the work piece is ground with a high degree of accuracy and consistency. Such control is achieved without the necessity of using excessive pressure between the control wheel and the work piece.

8 Claims, 2 Drawing Figures

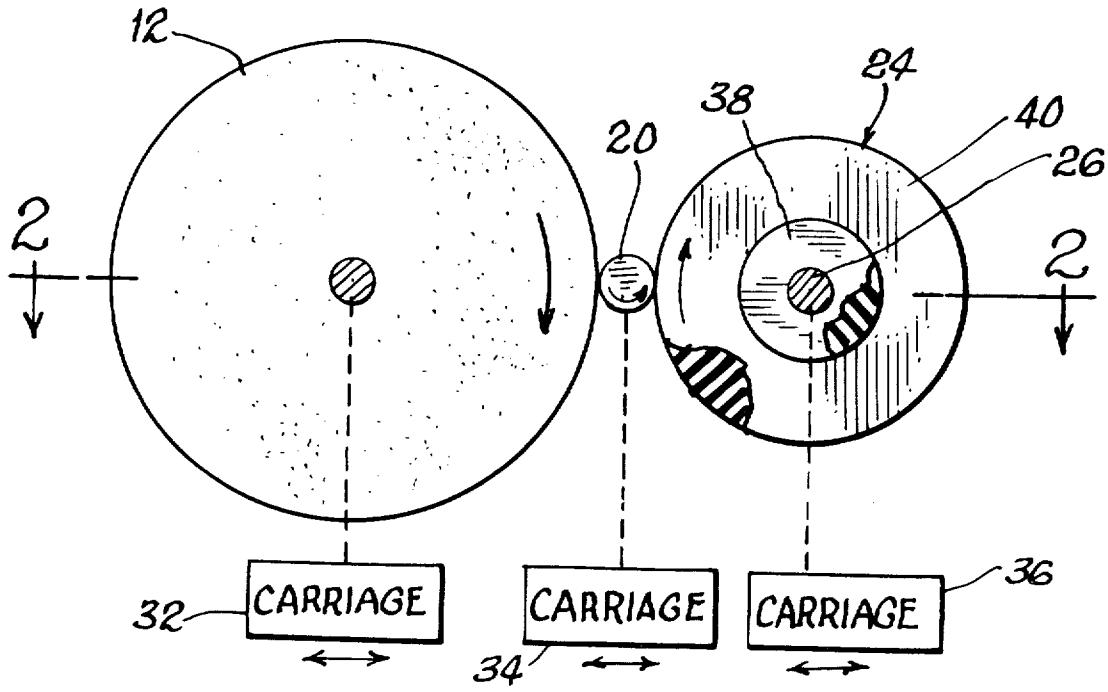


FIG. 1

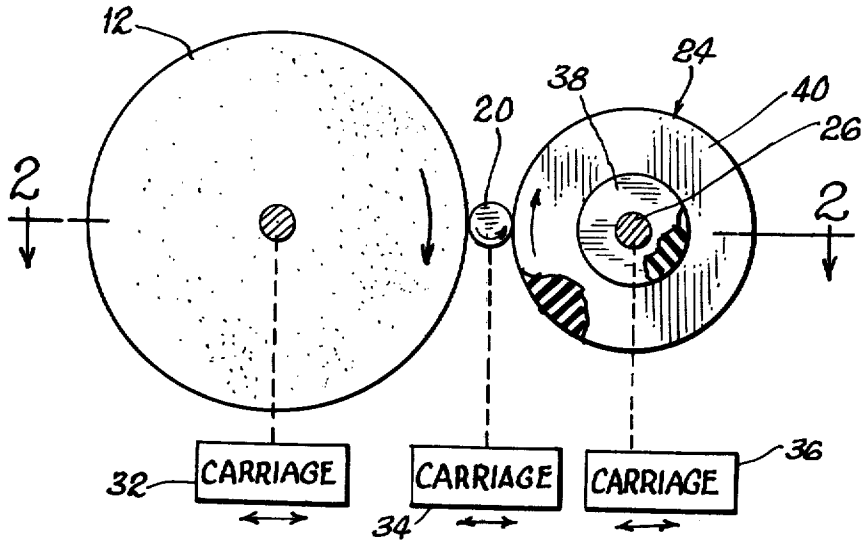
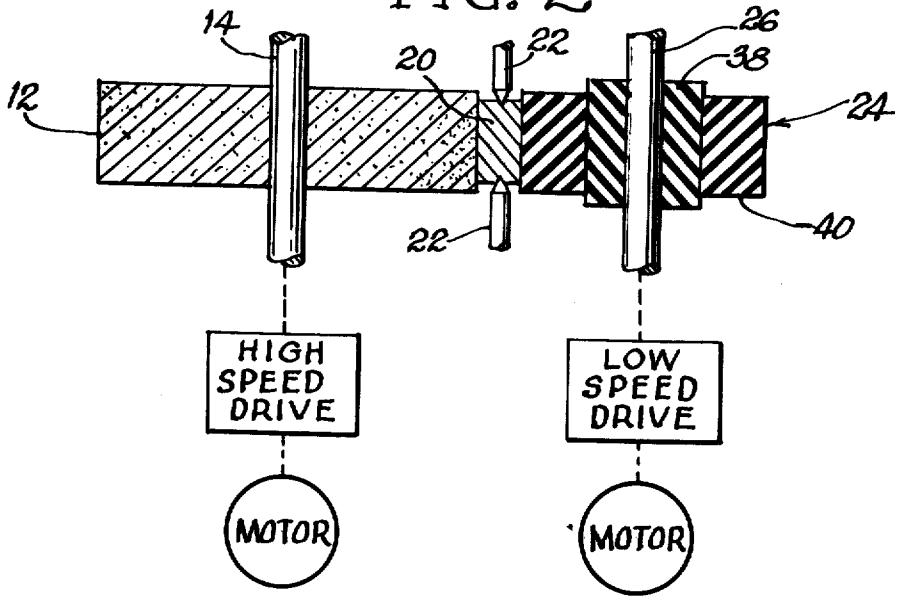

12
24
38
40
20
26
2
2
32
CARRIAGE
CARRIAGE
CARRIAGE
36
34

FIG. 2


14
26
22
20
38
12
24
22
40
HIGH SPEED DRIVE
LOW SPEED DRIVE
MOTOR
MOTOR

GRINDING MACHINE WITH RESILIENT CONTROL WHEEL

This invention relates to a grinding machine of the type which may be employed for grinding a precisely cylindrical surface on a generally cylindrical work piece. Such work pieces may be intended for use as gage pins, precision machine parts and the like.

This invention relates particularly to grinding machines of the type having a grinding wheel which is driven at a high surface speed, a pair of centers or other work piece supports for rotatably supporting the work piece while it is being ground, and a power driven control wheel which frictionally engages the work piece and is adapted to rotate the work piece while it is being ground.

In the past, the control wheel for such a grinding machine has generally been made of a fairly hard resilient material, such as natural or synthetic rubber, or the like.

Some difficulty has been experienced with grinding machines of this type, in that it has been difficult and sometimes impossible to maintain full driving engagement between the control wheel and the work piece, particularly when the work piece, when supplied to the grinding machine, is out of round or tapered. The inability to maintain full driving engagement between the control wheel and the work piece has decreased the level of precision with which the grinding operation is carried out. To maintain satisfactory control over the work piece, it sometimes has been necessary to use excessive driving pressure between the control wheel and the work piece. Such excessive pressure makes it difficult to keep the work piece properly centered.

In accordance with the present invention, the control wheel is composite in construction in that the wheel comprises a cylindrical inner core portion, made of a relatively soft, resilient, yieldable rubbery material, such as natural or synthetic rubber, and a cylindrical peripheral portion which is ring shaped and is securely mounted around the core portion. The ring shaped peripheral portion is made of a substantially harder resilient material, such as natural or synthetic rubber or the like. The provision of the soft inner core portion makes it possible for the control wheel to adapt itself to variations in the work piece, without any need to utilize excessive driving pressure between the control wheel and the work piece. Thus, full driving engagement can readily be maintained between the control wheel and the work piece, even if the work piece is out of round or tapered. The ring shaped peripheral portion of the control wheel is sufficiently hard to provide the best type of driving action between the control wheel and the work piece, while the inner core portion is soft enough to allow the control wheel to adapt itself to any irregularities in the work piece. With the grinding machine of the present invention, it is possible to grind precisely cylindrical surfaces on the work pieces, with an improved degree of accuracy.

Further objects, advantages and features of the present invention will appear from the following description, taken with the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic elevational view of a grinding machine to be described as an illustrative embodiment of the present invention.

FIG. 2 is a somewhat diagrammatic sectional view, taken generally along the line 2—2 in FIG. 1.

As just indicated, the drawings illustrate a grinding machine, comprising a rotatable grinding wheel **12** which may be mounted on a rotatable shaft **14.** The grinding wheel **12** is provided with means for rotating the grinding wheel at a relatively high surface speed. Such means may take the form of a motor **16** which is connected to the shaft **14** through a suitable high speed drive **18.**

The grinding wheel **12** is adapted to grind a generally cylindrical work piece **20,** which may be intended for use as a gage pin, a machine part or the like. In this grinding machine, the work piece **20** is positively supported for rotation about a particular axis. Thus, the work piece **20** may be rotatably supported by a pair of centers **22** or other suitable work piece supports. The work piece **20** is supported by the centers **22** while the work piece is being ground.

The work piece **20** is engaged by a control wheel **24** which is driven at a relatively low surface speed, compared with the surface speed of the grinding wheel **12.** The control wheel **24** is mounted on a rotatable shaft **26** which may be connected to a motor **28** through a low speed drive **30.** In some cases, the same motor may be employed to drive both the control wheel **24** and the grinding wheel **14.** However, it is often convenient to employ two motors as illustrated.

During the grinding operation, the control wheel **24** is in frictional driving engagement with the work piece **20,** so that the work piece is driven in a direction and at a speed determined by the direction and speed of rotation of the control wheel **24.**

As shown, the grinding wheel **12** is mounted on a laterally movable carriage **32,** while the work piece centers or supports **22** are mounted on another laterally movable carriage **34.** Similarly, the control wheel **24** is mounted on a laterally movable carriage **36.** The carriages **32** and **34** make it possible to adjust the grinding engagement between the grinding wheel **12** and the work piece **20.** The carriages **34** and **36** make it possible to adjust the driving engagement between the control wheel **24** and the work piece **20.** Suitable precision adjusting mechanisms may be employed to adjust the positions of the carriages **32, 34** and **36.**

While three laterally adjustable carriages **32, 34** and **36** are shown, it sometimes will suffice to provide only two of the three movable carriages, while still retaining the ability to adjust the grinding action between the grinding wheel **12** and the work piece **20,** and the driving action between the control wheel **24** of the work piece **20.**

In order to improve the frictional driving engagement between the control wheel **24** and the work piece **20,** the control wheel **24** preferably is composite in construction, in that it preferably comprises a relatively soft core portion **38** and a relatively hard peripheral ring shaped portion **40.** Both the inner core portion **38** and the outer peripheral portion **40** are preferably made of a resilient rubbery material, such as natural or synthetic rubber.

The core portion **38** of the control wheel **24** is preferably cylindrical in shape and is cemented, bonded or otherwise secured to the rotary shaft **26.** The outer peripheral portion **40** is preferably cylindrical and ring shaped and is bonded, cemented or otherwise securely mounted around the core portion **38.**

In order to provide the best type of frictional driving engagement with the work piece **20,** the outer ring

shaped portion **40** is preferably made of a relatively hard rubbery material, while the inner core portion **38** is preferably made of a relatively soft rubbery material. The provision of the soft inner core portion **38** makes it possible for the control wheel **24** to adapt itself to the work piece **20**, so that full frictional driving engagement will be maintained between the control wheel **24** and the work piece **20**, even if the work piece is out of round or tapered, or has other dimensional variations. The soft rubbery core portion **38** is sufficiently flexible and yieldable to permit the best type of full frictional driving engagement between the outer portion **40** and the work piece **20**, without any need for excessive pressure therebetween.

I claim:

1. A grinding machine, comprising

a grinding wheel,

first driving means for rotating said grinding wheel at a relatively high surface speed,

a pair of work piece supports for rotatably supporting a work piece for engagement with said grinding wheel,

a rotatable control wheel for frictionally engaging the work piece to rotate the work piece while it is being ground,

and a second driving means for rotating said control wheel at a relatively low surface speed compared with the surface speed of said grinding wheel,

said control wheel including a generally cylindrical inner core portion made of a relatively soft resilient yieldable rubbery material,

said control wheel including a generally cylindrical ring shaped outer peripheral portion mounted securely around said inner core portion and made of a resilient rubbery material which is substantially harder than the material of said inner core portion,

the softness and resilience of said inner core portion making it possible for the control wheel to adapt itself to variations in the work piece so as to achieve full driving engagement between the work piece and said control wheel.

2. A grinding machine according to claim **1**,

in which said inner core portion and said ring shaped peripheral portion of said control wheel are made of rubber materials,

said rubber material of said inner core portion being substantially softer than the rubber material of said ring shaped peripheral portion.

3. A grinding machine according to claim **1**,

in which said work piece supports take the form of a pair of centers for rotatably supporting the work piece.

4. A grinding machine according to claim **1**,

in which said inner core portion and said ring shaped outer portion of said control wheel are made of first and second different rubber materials,

said first rubber material of said inner core portion being substantially softer than said second rubber material of said outer peripheral portion,

said work piece supports taking the form of a pair of centers for rotatably supporting the work piece.

5. A grinding machine according to claim **4**,

including means for producing relative lateral adjusting movement between said work piece supporting centers and said control wheel for adjusting the driving pressure between said control wheel and the work piece.

6. A grinding machine according to claim **1**,

including means for producing relative lateral adjusting movement between said control wheel and said work piece supports for adjusting the driving pressure between said control wheel and the work piece.

7. A grinding machine according to claim **1**,

including means for producing relative lateral adjusting movement between said work piece supports and said grinding wheel to adjust the grinding engagement between said grinding wheel and the work piece.

8. A grinding machine according to claim **1**,

including means for producing relative lateral adjusting movement between said work piece supports and said control wheel for adjusting the driving pressure between said control wheel and the work piece,

and means for producing relative lateral adjusting movement between said work piece supports and said grinding wheel for adjusting the grinding engagement between said grinding wheel and the work piece.

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