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(54) **IMPROVEMENTS IN OR RELATING TO GRINDING MACHINES**

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Description

Field of the invention

[0001] This invention relates generally to grinding machines, and in particular to a grinding machine having two wheel heads, each carrying a grinding wheel, thereby to enable two positions along a workpiece to be ground simultaneously, for example when grinding cams on an engine camshaft.

Background to the invention

[0002] Dual wheel grinding machines are well known. It is also well understood that when a grinding wheel is in use, it can develop deformations from circularity, of several possible types, requiring the wheel to be reshaped with a dressing tool or a truing tool. In this specification, the term "dresser" is employed to refer to either a dressing tool or a truing tool, and the term "dress" to refer to either dressing or truing.

[0003] In the case of a dual wheel grinding machine, the grinding wheels are not necessarily the same size. It has been considered not practical to incorporate facilities for dressing or truing in the machine because of the space and complexity of design required to carry a normal two axes dressing unit on each wheelhead. In a machine having only a single grinding wheel, a separate head can be incorporated, but this is obviously not readily possible in a machine already having two wheel heads. It is conventional practice to demount the grinding wheels for dressing or truing.

[0004] WO-A-86/03706 discloses a method having the features of the preamble of claim 1 and a dual wheel grinding machine, having first and second wheel heads respectively carrying first and second grinding wheels. Each machine grinds a respective workpiece with each grinding tool having an associated concentric dresser.

[0005] It is an object of the present invention to provide a solution to the above-described problem.

The invention

[0006] According to one aspect of the invention, there is provided a dual wheel grinding machine having first and second wheel heads respectively carrying first and second grinding wheels, wherein the first and second wheel heads respectively also carry first and second grinding wheel dressers and the two wheel heads are relatively movable to enable the first dresser to dress the second grinding wheel and to enable the second dresser to the dress the first grinding wheel.

[0007] According to another aspect of the invention, there is provided a method of truing or dressing the grinding wheels of a dual wheel head grinding machine, according to which the two wheel heads, in addition to axially separated first and second grinding wheels, respectively carry first and second dressers, characterised by the step of moving the first wheel head past the second wheel head to enable the first dresser to dress the second grinding wheel.

[0008] Preferably, the two wheel heads are each movable in two coordinate directions, firstly a lateral movement towards and away from one another and secondly a feed movement at right angles thereto. The lateral movement is preferably parallel to an axis through the first and second grinding wheels, which may be coaxial, and the feed movement is at right angles to said axis and enables the infeed/outfeed movement of the respective grinding wheel relative to the workpiece, as well as engagement of the respective dresser with a grinding wheel.

[0009] The first and second dressers on the two wheel heads are desirably not aligned, but both preferably lie in a plane normal to the axial plane through the axis of the grinding wheels containing the directions of movement of the wheel heads, but respectively on opposite sides of this axial plane. Registration of the dressers in this way, relative to the grinding wheels, enables the first dresser to move past the second dresser when the first dresser is employed to dress the second grinding wheel, and vice versa.

[0010] It is an obvious requirement, if the two dressers are mounted in fixed relationship to the respective wheel heads, for the two dressers to be positioned closer together than the two grinding wheels in the normal condition in which grinding takes place, each dresser preferably being spaced further from the wheel head which carries it than the grinding wheel carried by that wheel head.

[0011] Correct lateral positioning calibration is preferably achieved by means of a probe on one wheel head and an anvil on the other. Contact between them may signal a stop command to the drive producing the lateral movement. The feed movement which brings the first dresser into contact with the second grinding wheel, or the second dresser into contact with the first grinding wheel, is judged by touch contact in a conventional manner. The probe may be adjustable between two conditions if, as is preferred, the lateral movement for bringing the first dresser into alignment with the second grinding wheel is not the same as that for bringing the second dresser into alignment with the first grinding wheel.

[0012] Dressing may be effected by movement of one wheel head only.

[0013] Again, if the dressers are mounted in fixed relationship to the respective wheel heads, all lateral relative movement between the wheel heads for effecting dressing is preferably carried out by the wheel head carying the grinding wheel to be dressed, although this is not essential.

[0014] Mounting the dressers in fixed relationship to the wheel heads places limitations on the difference between the sizes of the grinding wheels which can be dressed, posssibly on the extent of non-axial alignment

of the grinding wheels necessary for grinding different parts of a workpiece, and possibly also on the difference between the amounts of dressing of the respective grinding wheels which is practicable.

[0015] In a preferred machine, therefore, the dressers are mounted each to be laterally movable independently of the lateral movement of the wheel heads which carry the respective dressers. For example, the dressers may each be mounted on a slide which is itself mounted to be laterally slidable on a guide means carried by the corresponding wheel head.

[0016] This avoids any possible problem of fouling between the non-operative dresser and the second grinding wheel when the operative dresser is aligned with the first grinding wheel, and vice versa.

Description of embodiments

[0017] Embodiments of dual wheel head grinding machine are now described by way of example with reference to the accompanying drawings, in which:-

Figures 1, 2 and 3 respectively show a simple machine diagrammatically in plan, side, and rear views, for enabling the principle of the invention to be understood;

Figure 4 is a diagrammatic plan view of a preferred machine in a typical condition for dual grinding of a workpiece;

Figure 5 is a corresponding view when the machine is in a typical condition for dressing one of the grinding wheels;

Figure 6 is a diagrammatic view of a dressing wheel slide assembly; and

Figure 7 shows a slide in perspective.

[0018] Referring to Figures 1 to 3, the illustrated grinding machine has two wheel heads 10, 12 respectively carrying grinding wheels 14, 16 in coaxial relationship for grinding two spaced positions along a workpiece 18 rotatable betwen a headstock 20 and a tailstock 22. A rotary drive for each grinding wheel 14, 16 is housed within the respective wheel head, and the infeed/outfeed movement of each grinding wheel is produced by a controlled feed movement of the respective wheel head, as indicated by the arrows 24, 26.

[0019] In addition to the grinding wheels 14, 16, the wheel heads 10, 12 respectively carry dressing or truing tools 28, 30, herein referred to as dressers. The dressers 28, 30, however, are not coaxial, but disposed on opposite sides of a vertical plane through the axis of the grinding wheels, as will be clear from Figures 2 and 3.

[0020] Each wheel head, in addition to its vertical feed movement, is laterally movable towards the other wheel head, as indicated by the arrows 32, 34.

[0021] Thus, as indicated in dashed line at 14A, it is possible laterally to move grinding wheel 14 beneath dresser 30, or alternatively to move grinding wheel 16 laterally to position it beneath dresser 28. Correct lateral positioning is ensured by means of a probe 36 on the wheel head 12 and a corresponding anvil 38 on the wheel head 10.

[0022] Subsequently, by use of the available feed movement of one of the wheel heads 10, 12, the dresser 30 can be engaged with the grinding wheel 14 to effect dressing, or likewise for the grinding wheel 16 and dresser 28.

[0023] It will be noted that the two dressers 28, 30 pass one by the other during the lateral feed movement effected in readiness for dressing, and it is possible that each dresser may be vertically aligned with a grinding wheel at the end of this feed movement. However, simultaneous dressing of both grinding wheels is not possible because the respective distances between the centres of the respective pairs of grinding wheels and dressers will not be the same. Moreover, although not illustrated, the two dressers 28, 30 are preferably mounted at different distances from the sides of the wheel heads 10, 12 such that when one dresser 28 is truing grinding wheel 16, the other dresser 30 is laterally displaced from, i.e. non-aligned with, its grinding wheel 14. The sensing means 36, 38 may be adjustable to allow for the different lateral movements to be carried out when the respective pairs of grinding wheels and dressers are to be aligned. In addition to the impracticality of simultaneous dressing, the vertical feed movement of one dresser (or grinding wheel) necessary for dressing increases the separation of the other dresser and grinding wheel. On the other hand, it is not essential for the lateral movement required for dressing to be performed by the wheel head carrying the grinding wheel to be dressed, nor indeed for this relative lateral movement to be performed solely by one wheel head.

[0024] The dresser 30, 28 traverses across the face of the grinding wheel 14, 16 to dress, or true the wheel. The actual grinding and dressing or truing processes carried out by the machine are not herein described, because they are practised in a wholly conventional manner.

[0025] Notwithstanding Figures 1 to 3, it is to be understood that the invention is not limited to machines which have grinding wheels of equal diameter, nor to the requirement to dress the respective grinding wheels by equal amounts.

[0026] A preferred, more versatile machine is illustrated in Figures 4 to 7, wherein the same reference numerals as Figures 1 to 3 are employed for corresponding parts.

[0027] In the preferred machine, the dressers 28, 30 are mounted on respective slides 40, 42 which are themselves slidably mounted for lateral movement of the dressers on guides 44 (see Figure 7) housed within

the respective wheel heads 10, 12. References 46, 48 denote driving means for the respective slides 40, 42.

[0028] In Figure 4, the machine is shown in the condition for conventional dual grinding of a workpiece by the spaced grinding wheels 14, 16. For grinding different parts of the workpiece, the grinding wheels 14, 16 are shown non-aligned axially. Moreover, although not shown, these grinding wheels could be of quite substantially different diameters. The axes of the dressers 28, 30 again lie in front of and behind the plane of the Figure 4 drawing, as is apparent from the plan view of a wheel head shown in Figure 6, in which reference 50 denotes the axis of the grinding wheel 14, typically a diamond wheel, and reference 52 denotes the axis of the dresser 28, typically a carbonboron wheel.

[0029] Figure 5 shows the machine when in the condition for truing the grinding wheel 16 with the dresser 28. Slide 40 has been operated, in conjunction with a relative lateral movement of the wheel heads 14, 16, possibly to an extent controlled by a suitable sensing means (not shown), to bring dresser 28 into alignment with grinding wheel 16. Relative vertical movement of the two wheel heads 14, 16 is being carried out to effect truing.

[0030] Figure 6 also shows, in diagrammatic manner, one possible form of drive means 46, 48 contained within each wheel head 14, 16, for effecting movement of the slide. This drive means may be electrically or hydraulically powered, for example.

Claims

1. A method of truing or dressing the grinding wheels of a dual wheel head grinding machine, according to which the two wheel heads (10, 12), in addition to axially separated first and second grinding wheels (14, 16), respectively carry first and second dressers (28, 30), characterised by the step of moving the first wheel head (10) past the second wheel head (12) to enable the first dresser (28) to dress the second grinding wheel (12).

2. A dual wheel grinding machine having first and second wheel heads (10, 12) respectively carrying first and second grinding wheels (14, 16), wherein the first and second wheel heads respectively also carry first and second grinding wheel dressers (28, 30) and the two wheel heads are relatively movable to enable the first dresser (28) to dress the second grinding wheel (16) and to enable the second dresser (28) to the dress the first grinding wheel (14).

3. A dual wheel grinding machine according to claim 2, wherein the two wheel heads (10, 12) are each movable in two coordinate directions, firstly a lateral movement towards and away from one another and secondly a feed movement at right angles thereto.

4. A dual wheel head grinding machine according to claim 3, wherein the lateral movement is parallel to an axis through the first and second grinding wheels (14, 16) and the feed movement is at right angles to said axis and enables the infeed/outfeed movement of the respective grinding wheel relative to a workpiece (18) as well as engagement of the respective dresser with a grinding wheel.

5. A dual wheel head grinding machine according to claim 4, wherein the axis through the first and second grinding wheels is coaxial.

6. A dual wheel head grinding machine according to any of claims 2 to 5, wherein the first and second dressers in the two wheel heads are not aligned but both lie in a plane normal to the axial plane through the axis of the grinding wheels containing the directions of movement of the wheel heads, and are respectively on opposite sides of this axial plane so as to enable the first dresser to move past the second dresser when the first dresser is employed to dress the second grinding wheel, and vice versa.

7. A dual wheel head grinding machine according to any of claims 2 to 6, wherein correct lateral positioning calibration is achieved by means of a probe on one wheel head and an anvil on the other wheel head.

8. A dual wheel head grinding machine according to claim 7, wherein the probe and anvil signals a stop command to the drive producing the lateral movement.

9. A dual wheel head grinding machine according to claim 7 or claim 8, wherein the probe is adjustable between two conditions when the lateral movement for bringing the first dresser into alignment with the second grinding wheel is not the same as that for bringing the second dresser into alignment with the first grinding wheel.

10. A dual wheel head grinding machine according to any of claims 2 to 9, wherein dressing is effected by movement of one wheel head only.

11. A dual wheel head grinding machine according to any of claims 2 to 10, having the dressers (28, 30) mounted in fixed relationship to the respective wheel heads (10, 12) wherein all lateral relative movement between the wheel heads for effecting dressing is carried out by the wheel head carrying the grinding wheel to be dressed.

12. A dual wheel head grinding machine according to any of claims 2 to 11, wherein the dressers (28, 30) are mounted each to be laterally movable inde-

pendently of the lateral movement of wheel heads (10, 12) which carry the respective dressers.

Patentansprüche

1. Ein Verfahren zum Abziehen oder Abdrehen der Schleifscheiben einer Doppelkopf-Schleifmaschine, gemäß dem die beiden Schleifköpfe (10, 12) zusätzlich zu einer ersten und einer zweiten axial voneinander getrennten Schleifscheibe (14 bzw. 16) eine erste und eine zweite Abdrehvorrichtung (28, 30) tragen, gekennzeichnet durch die Stufe des axialen Bewegens des ersten Schleifkopfes (10) entlang des zweiten Schleifkopfes (12), damit die erste Abdrehvorrichtung (28) zum Abdrehen der zweiten Schleifscheibe (16) befähigt wird.

2. Eine Doppelkopf-Schleifmaschine mit einem ersten und einem zweiten Schleifkopf (10, 12), die eine erste bzw. eine zweite Schleifscheibe (14, 16) tragen, wobei der erste bzw. der zweite Schleifkopf auch eine erste und eine zweite Schleifscheibenabdrehvorrichtung (28, 30) trägt und die beiden Schleifköpfe relativ zueinander bewegbar sind, um die erste Abdrehvorrichtung (28) zum Abdrehen der zweiten Schleifscheibe (16) und die zweite Abdrehvorrichtung (30) zum Abdrehen der ersten Schleifscheibe (14) zu befähigen.

3. Eine Doppelkopf-Schleifmaschine nach Anspruch 2, wobei die beiden Schleifköpfe (10, 12) beide in zwei Koordinatenrichtungen verschiebbar sind, zuerst in einer seitlichen Bewegung in Richtung aufeinander zu und voneinander weg und zweitens in einer in rechten Winkeln dazu stehenden Vorschubbewegung.

4. Eine Doppelkopf-Schleifmaschine nach Anspruch 3, wobei die seitliche Bewegung parallel zu einer durch die erste und die zweite Schleifscheibe (14, 16) durchtretenden Achse und die Vorschubbewegung unter rechten Winkeln zu der Achse liegt und die Hin- und Wegbewegung der jeweiligen Schleifscheibe gegenüber einem Werkstück (18) wie auch die Anlage der jeweiligen Abdrehvorrichtung an einer Schleifscheibe zuläßt.

5. Eine Doppelkopf-Schleifmaschine nach Anspruch 4, wobei die Achsen durch die erste und die zweite Schleifscheibe koaxial zueinander sind.

6. Eine Doppelkopf-Schleifmaschine nach irgendeinem der Ansprüche 2 bis 5, wobei die erste und die zweite Abdrehvorrichtung in den beiden Schleifköpfen nicht ausgerichtet sind, aber beide in einer Ebene liegen, die zu der Axialebene, die durch die Achse der Schleifscheiben durchtritt, senkrecht steht und die die Bewegungsrichtungen der Schleifköpfe enthält, bzw. auf sich gegenüberliegenden Seiten dieser axialen Ebene liegen, so daß sich die erste Abdrehvorrichtung an der zweiten Abdrehvorrichtung vorbeibewegen kann, wenn die erste Abdrehvorrichtung zum Abdrehen der zweiten Schleifscheibe verwendet wird, und umgekehrt.

7. Eine Doppelkopf-Schleifmaschine nach irgendeinem der Ansprüche 2 bis 6, wobei die richtige Kalibrierung der Seitenlage mit Hilfe eines Fühlers auf einem Schleifkopf und eines Tastbolzens auf dem anderen Schleifkopf erreicht wird.

8. Eine Doppelkopf-Schleifmaschine nach Anspruch 7, wobei der Fühler und der Tastbolzen dem die Seitenbewegung bewirkenden Antrieb ein Haltesignal zuführen.

9. Eine Doppelkopf-Schleifmaschine nach Anspruch 7 bder Anspruch 8, wobei der Fühler zwischen zwei Zuständen verstellbar ist, wenn die Seitenbewegung zum Verbringen der ersten Abdrehvorrichtung in eine Ausrichtung mit der zweiten Schleifscheibe nicht die gleiche ist wie die zum Verbringen der zweiten Abdrehvorrichtung in Ausrichtung mit der ersten Schleifscheibe.

10. Eine Doppelkopf-Schleifmaschine nach irgendeinem der Ansprüche 2 bis 9, wobei das Abdrehen durch eine Bewegung nur eines Schleifkopfes bewirkt wird.

11. Eine Doppelkopf-Schleifmaschine nach irgendeinem der Ansprüche 2 bis 10 mit einer Lage der Abdrehvorrichtung (28, 30) in einer festen Beziehung zu dem jeweiligen Schleifkopf (10, 12), wobei die gesamte seitliche Relativbewegung zwischen den Schleifköpfen zum Bewirken des Abdrehens von dem Schleifkopf bewirkt wird, der die abzudrehende Schleifscheibe trägt.

12. Eine Doppelkopf-Schleifmaschine nach irgendeinem der Ansprüche 2 bis 11, wobei die Abdrehvorrichtungen (28, 30) unabhängig von der Seitenbewegung der die jeweilige Abdrehvorrichtung tragenden Schleifköpfe (10, 12) beide seitlich verschiebbar sind.

Revendications

1. Procédé de dégauchissage ou de dressage des roues de meulage d'une meuleuse à deux têtes de meule, selon lequel les deux têtes de meule (10, 12), en plus d'une première et une seconde roues de meulage (14, 16) séparées axialement, supportent respectivement un premier et un second outil de dressage (28, 30), caractérisé en ce qu'il comporte l'étape consistant à déplacer la première tête

de meule (10) au-delà de la seconde tête de meule (12) pour permettre au premier outil de dressage (28) de dresser la seconde roue de meulage (16).

2. Meuleuse à deux roues ayant une première et une seconde tête de meule (10, 12) supportant respectivement une première et une seconde roue de meulage (14, 16) dans laquelle la première et la seconde tête de meule supportent aussi respectivement un premier et un second outil de dressage de roue de meulage (28, 30) et dans laquelle les deux têtes de meule sont mobiles l'une par rapport à l'autre pour permettre au premier outil de dressage (28) de dresser la seconde roue de meulage (16) et pour permettre au second outil de dressage (30) de dresser la première roue de meulage (14).

3. Meuleuse à deux roues selon la revendication 2, dans laquelle les deux têtes de meule (10, 12) sont chacune mobiles dans deux directions orthogonales, tout d'abord dans un mouvement latéral en direction l'une de l'autre et en s'éloignant l'une de l'autre et deuxièmement dans un mouvement d'acheminement à angle droit par rapport à celui-ci.

4. Meuleuse à deux têtes de meule selon la revendication 3, dans laquelle le mouvement latéral est parallèle aux axes des première et seconde roues de meulage (14, 16) et le mouvement d'acheminement est à angle droit par rapport auxdits axes et permet le mouvement d'attaque/retrait de la roue de meulage respective par rapport à une pièce à usiner (18) ainsi que la mise en contact du dispositif de dressage respectif avec une roue de meulage.

5. Meuleuse à deux têtes de meule selon la revendication 4, dans laquelle les axes des première et seconde roues de meulage sont coaxiaux.

6. Meuleuse à deux têtes de meule selon l'une quelconque des revendications 2 à 5, dans laquelle le premier et le second outil de dressage situés dans les deux têtes de meule ne sont pas alignés mais se trouvent tous deux dans un plan perpendiculaire au plan axial passant par les axes des roues de meulage contenant les directions de déplacement des têtes de meule, et sont respectivement sur des côtés opposés de ce plan axial de manière à permettre au premier outil de dressage de se déplacer au-delà du second outil de dressage lorsque le premier outil de dressage est utilisé pour dresser la seconde roue de meulage, et vice versa.

7. Meuleuse à deux têtes de meule selon l'une quelconque des revendications 2 à 6, dans laquelle le réglage du positionnement latéral correct est obtenu par l'intermédiaire d'une sonde située sur une première tête de meule et d'une touche fixe située sur l'autre tête de meule.

8. Meuleuse à deux têtes de meule selon la revendication 7, dans laquelle la sonde et la touche fixe envoient un signal d'instructions d'arrêt vers l'entraînement produisant le mouvement latéral.

9. Meuleuse à deux têtes de meule selon la revendication 7 ou 8, dans laquelle la sonde peut être réglée entre deux états lorsque le mouvement latéral destiné à amener le premier outil de dressage en alignement avec la seconde roue de meulage n'est pas le même que celui destiné à amener le second outil de dressage en alignement avec la première roue de meulage.

10. Meuleuse à deux têtes de meule selon l'une quelconque des revendications 2 à 9, dans laquelle le dressage est effectué par déplacement d'une tête de meule seulement.

11. Meuleuse à deux têtes de meule selon l'une quelconque des revendications 2 à 10, comportant les outils de dressage (28, 30) montés selon une relation fixe sur les têtes de meule respectives (10, 12), dans laquelle tout mouvement latéral relatif entre les têtes de meule pour effectuer un dressage est exécuté par la tête de meule supportant la roue de meulage à dresser.

12. Meuleuse à deux têtes de meule selon l'une quelconque des revendications 2 à 11, dans laquelle les outils de dressage (28, 30) sont montés chacun pour être mobiles latéralement indépendamment du mouvement latéral des têtes de meule (10, 12) qui supportent les outils de dressage respectifs.

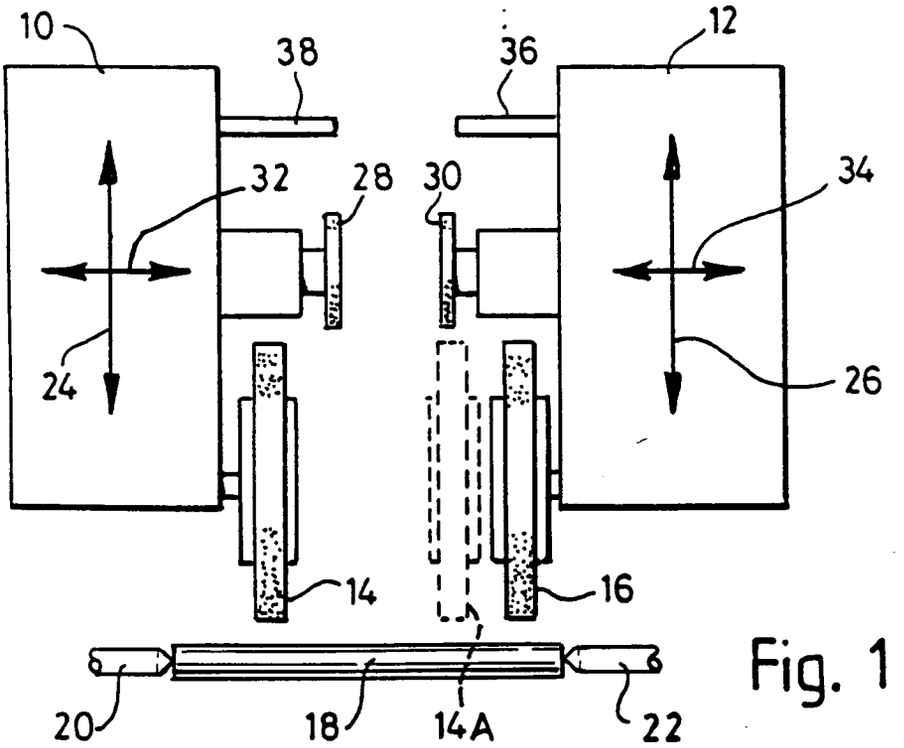

Fig. 1

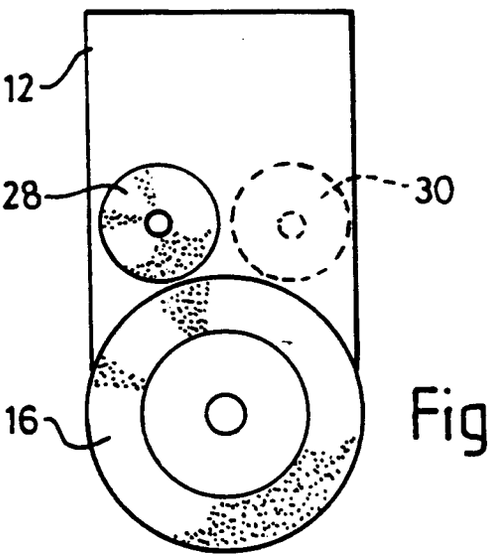

Fig. 2

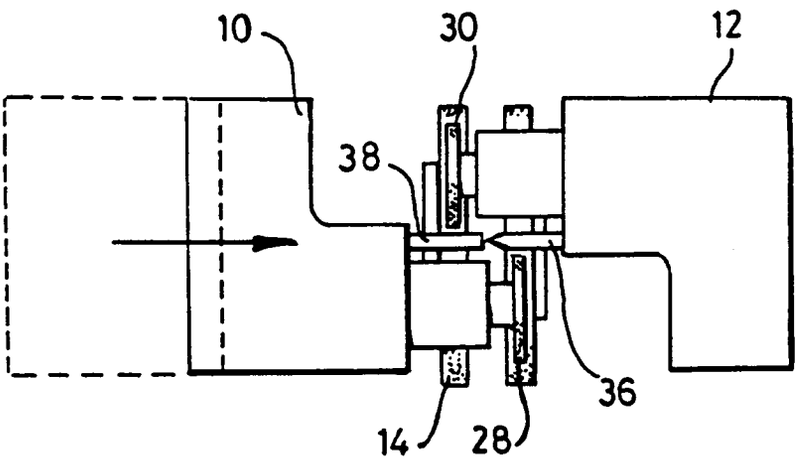

Fig. 3

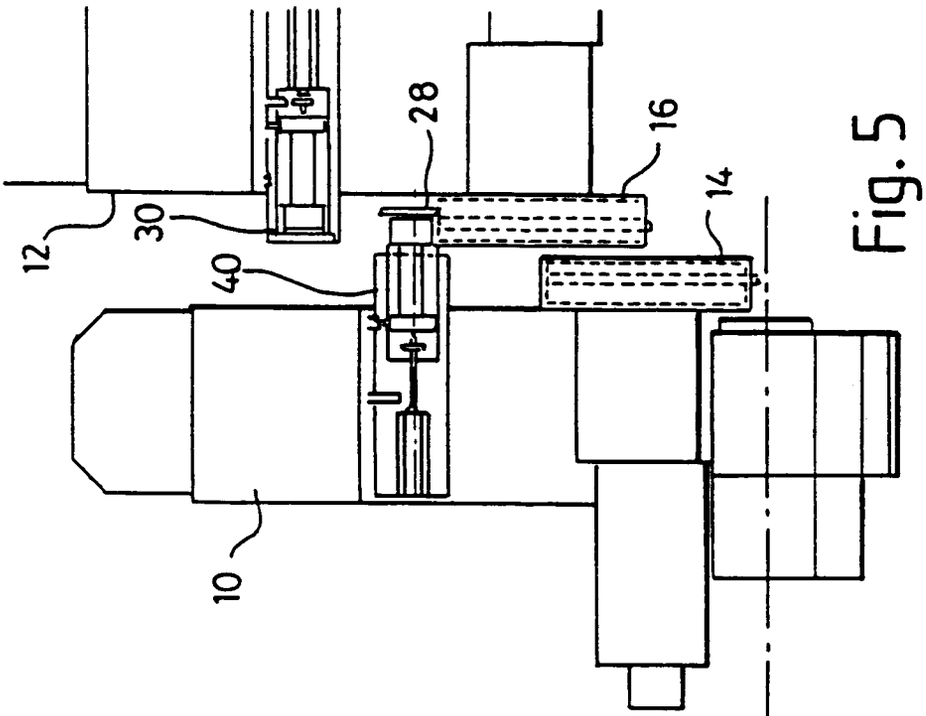

Fig. 5

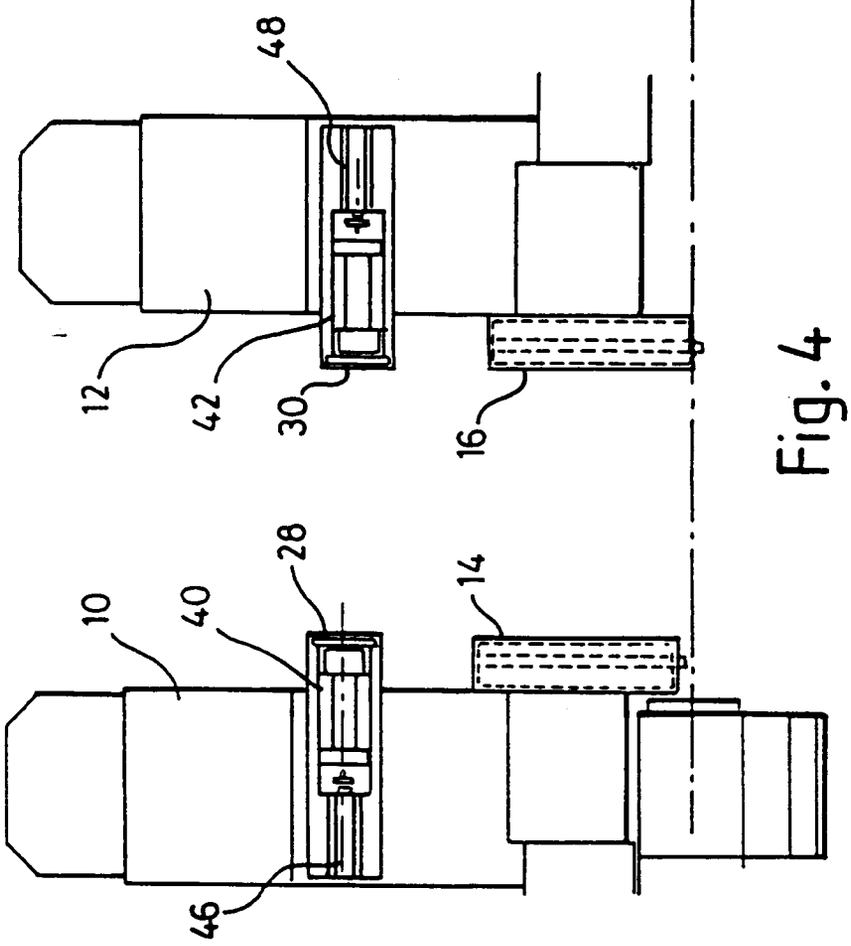

Fig. 4

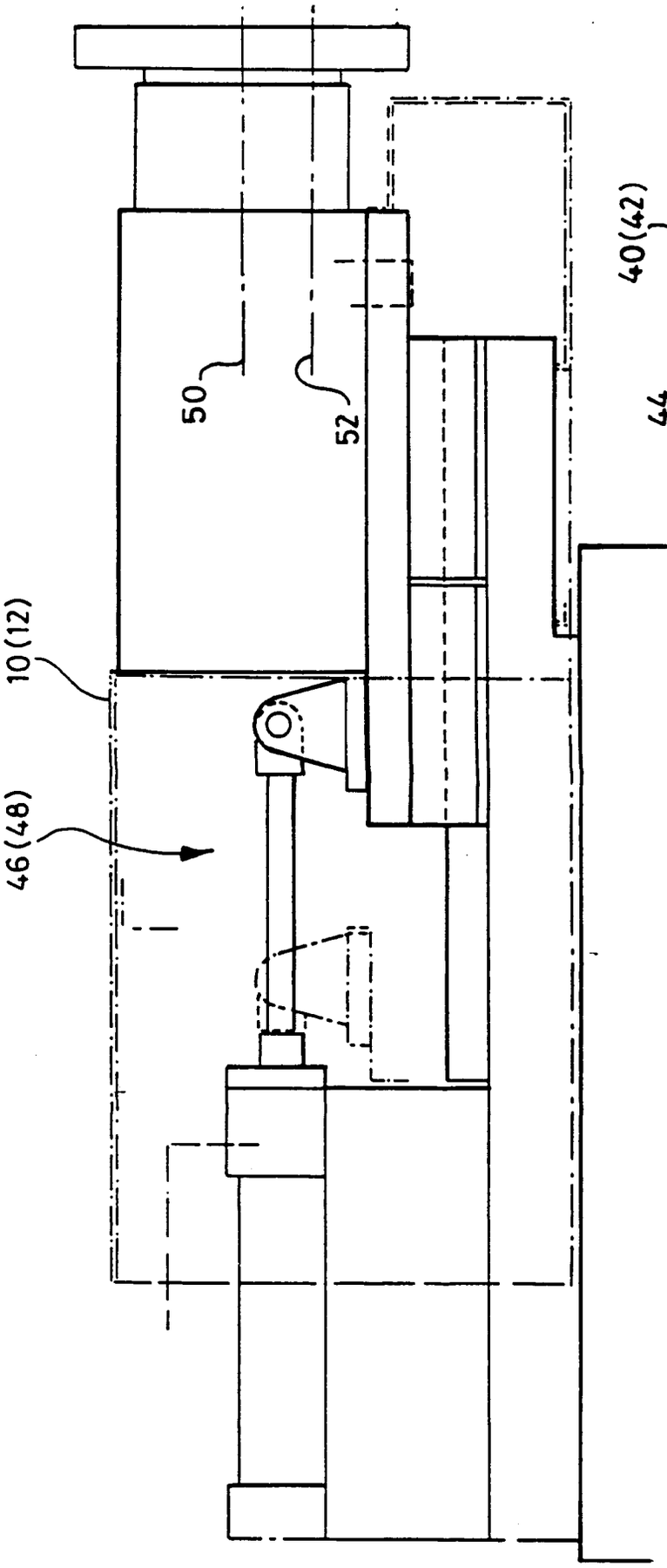

Fig. 6

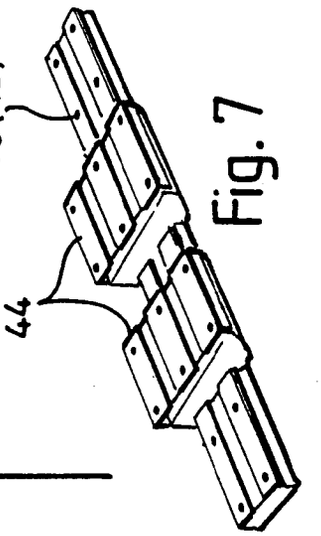

Fig. 7