

March 4, 1941.

W. SCHÜBBE

2,233,822

DRILLING MACHINE

Filed April 4, 1938

2 Sheets-Sheet 1

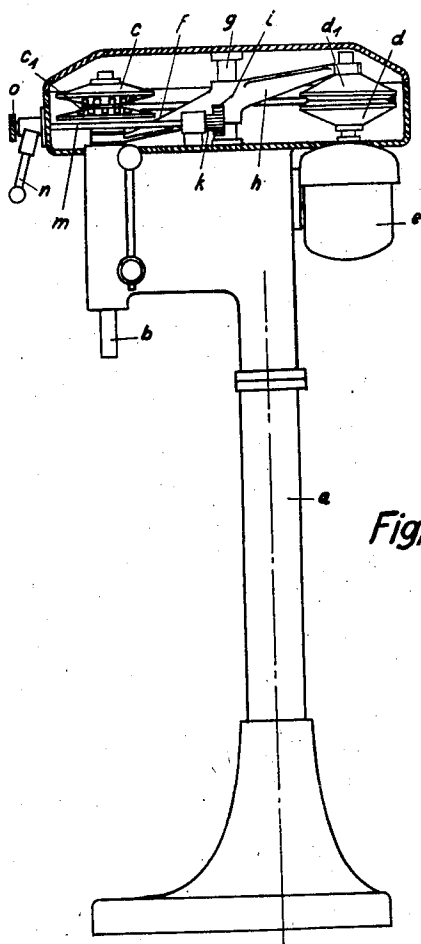


Fig. 1

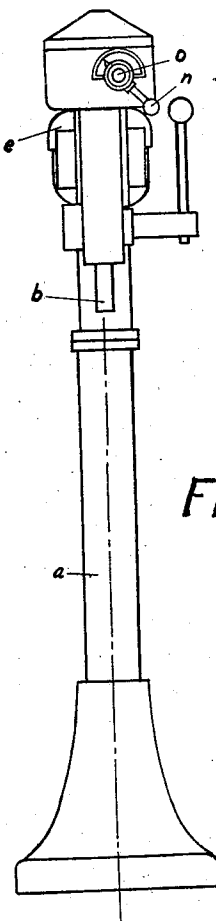


Fig. 2

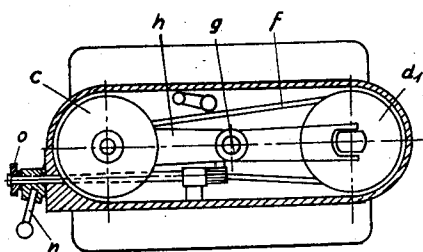


Fig. 3

Inventor:

Willy Schübbe

by
Watson, Cole, Grindle & Watson
Attorney

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2 Sheets-Sheet 2

Fig. 4.

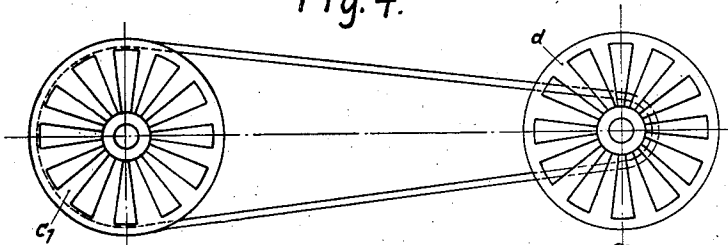


Fig. 5

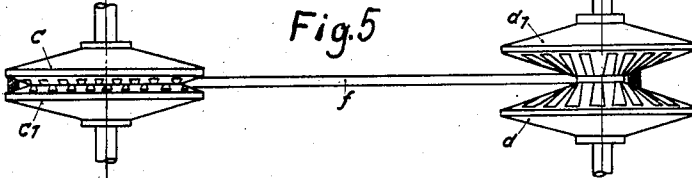


Fig. 6

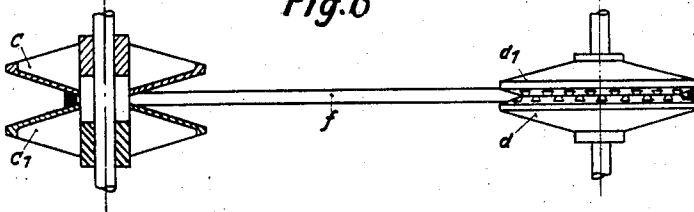
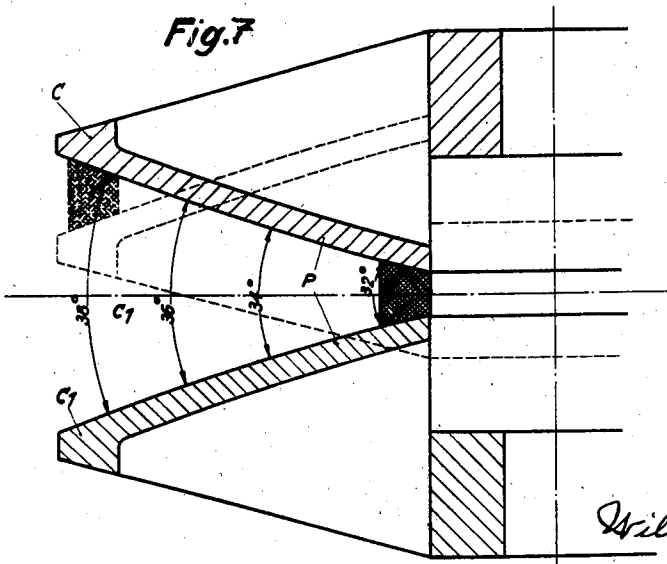


Fig. 7



Inventor:

Willy Schübbe

by
Watson, Cole, Grindle & Watson
Attorney

UNITED STATES PATENT OFFICE

2,233,822

DRILLING MACHINE

Willy Schübbe, Saalfeld-on-the-Saale, Germany,
 assignor to Auerbach & Scheibe, Saalfeld-on-
 the-Saale, Germany, a partnership consisting
 of Hans Helmut Wilkens and Willi Starcke

Application April 4, 1938, Serial No. 199,946
 In Germany April 7, 1937

1 Claim. (Cl. 74—230.17)

It is known to rigidly mount stepless gears in drilling machines. Hitherto, however, this was only possible in the case of the larger types of drilling machines because the gears employed are so expensive to manufacture that they cannot be considered for use in small, simple and cheap drilling machines. The cost of production of the gear alone was often higher than that for all the other machine parts. Consequently simple and cheap drilling machines could hitherto only be provided with stepped speed regulation.

This objection is overcome by the present invention which provides a stepless gear which comprises two pairs of conical discs slidable one within the other, over which a V section belt runs. Such gears are known, but were hitherto only used as auxiliary gearing, or independent countershafts, such as overhead countershafts. The use of this gear fitted in drilling machines offers the advantage that on account of its low cost of production even small, simple and cheap drilling machines may be made with stepless change gears, with a much larger range of speeds than would hitherto be obtained. Experiments have shown that the gear is perfectly suitable for the novel application and that the reduction in the cost of production of the stepless gear is such that small types of accurately operating drilling machines can be provided therewith without becoming too expensive. The only expense which has to be incurred for the periodical renewal of the V-section belt is so slight that this expense is justified in view of the technical improvement of simple machines without extra cost in the production of the whole machine.

A small bench drilling machine is known, in which the drive is transmitted from the pulley of a motor mounted on the base plate of the machine over a tension pulley shiftable on a line inclined to the vertical and comprising one pair of conical discs slidable one within the other, these discs being mounted on the drilling spindle and shiftable to vary the speed of rotation. This construction has only a small range of adjustment and possesses the disadvantage that only round belts can be used, as a V-section belt cannot be deflected laterally over the tension pulley. Furthermore the round belt does not sit well because it does not run off in all operative positions in the plane of the driving pulley of the motor, but at an acute angle thereto, and also possesses the objection that it wears quickly. Consequently the machine does not work accurately and is unsuitable for high-grade work.

Now, the invention is based on the knowledge

that, by the employment of two pairs of conical discs shiftable one within the other the drilling spindle can be run up to maximum speed without flapping and slipping of the belt and that the gear can consequently be employed for turning out first class work on precision drilling machines.

According to another feature of the invention the belt guiding surfaces of the conical discs are slightly curved. The bulging of the friction surfaces is such, that the angle between the friction surfaces of the discs increases from the axis towards the periphery corresponding to the change of the angle between the contact surfaces of the V-section belt when the bending radius changes. The angle preferably increases from 32 to 38 degrees. The change of angle is provided because when the belt is bent to small bending radius, the inner edge of the belt is flattened with the result that its contact surfaces form a smaller angle than in the case of a larger bending radius when the inner side of the belt expands.

Other features of the invention can be seen from the form of construction illustrated by way of example in the accompanying drawings, in which—

Fig. 1 is a side elevation of a drilling machine fitted with stepless gear, the gear case being shown in section,

Fig. 2 is a front elevation of Fig. 1,

Fig. 3 is a top plan view of Fig. 1 with the gear case in section,

Fig. 4 shows in bottom plan view the upper discs of the pairs of discs of the gear.

Fig. 5 is a side view showing the pairs of discs in one extreme position.

Fig. 6 is a similar view to Fig. 5 showing the pairs of discs in their other extreme position, one pair of discs being in central section.

Fig. 7 shows on an enlarged scale a portion of one pair of discs in radial section.

a designates the body of a drilling machine carrying a drilling spindle *b*. On the upper end of this spindle *b* a pair of conical discs *c*, *cl* is mounted, these discs having bevelled guide surfaces for a V-section belt *f*. The conical discs are alternately provided with recesses and projections so that they can interengage (Figs. 4 to 6). The V-section belt *f* runs over another pair of interengaging conical discs *d*, *dl* mounted on the shaft of an electric motor *e*. Intermediate the pairs of discs *c*, *cl* and *d*, *dl* a vertical bolt *g* is arranged on which a two-armed lever *h* is shiftable parallel to the axes of the pairs of discs. This lever *h* engages the lower disc *cl* of the pair of discs *c*, *cl* and the upper disc *dl* of the pair

discs d , dl . By shifting the lever h the discs of the pairs are relatively moved in opposite directions, so that a change in the ratio of transmission between the motor shaft and the spindle b takes place in known manner. The two extreme positions of the pairs of discs are illustrated in Figs. 5 and 6 respectively. Fig. 5 shows the pair of discs c , cl in telescoped position so that the V-section belt runs on the outer portion of the groove formed by the peripheries, whereas the discs d , dl are in their extreme separated position, and the belt bears on the inner portion of the groove formed by the peripheries. Thus the spindle b is rotated at a minimum speed. Fig. 6 shows the pair of discs c , cl in their extreme separated position, whereas the discs d , dl are telescoped. The spindle b then runs at maximum speed. When the pairs of discs are in intermediate positions there is a gradual change from minimum to maximum speed, so that any desired speed can be set without steps.

The two-armed lever h is shifted by means of a handle n mounted on a shaft m carrying a pinion k which meshes with a rack i mounted on the lever h . By turning the handle n the lever h is shifted and the spindle driven at a desired number of revolutions which can be read on a scale. The handle is arranged on the machine so that it is in easy reach of the operator. The handle can be fixed in any desired position by a clamping nut o , to ensure that the adjusted transmission remains constant.

Fig. 7 shows on enlarged scale a pair of discs, whose guide surfaces for the V-section belt are designated by p . The guide surfaces are slightly curved in such a manner that the angle between the opposite guide surfaces of two discs is 32 degrees at the portion nearest the axis and increases to 38 degrees towards the periphery. The reason for this measure is, that the V-section belt when bearing against the inner circumferential portion of the discs is more sharply bent than when it contacts with the outer circumferential portion of the discs. Under sharp bending the inner portion of the V-section belt thickens in such a manner that the angle formed by its contact faces is smaller than when the belt is bent to a large radius, that is when it bears on the outer circumferential portion of the pairs of discs. Owing to the curving the belt always

sits well on the whole of its contacting surface irrespectively of the positions of the discs, so that its pulling capacity is favourable, and its life is prolonged.

The fitting of the stepless gear above described necessitates such slight expenses that even small, simple and cheap drilling machines may be provided with stepless change gears with a large range of speeds. The costs of maintenance of the gear are very low; whereas in other gears the relatively expensive rings, cones, friction wheels and the like must be renewed when worn, the renewals in the gear above described are restricted to the very much cheaper V-section belts.

I claim:

A drilling machine capable of wide variation in the speeds of operation depending upon the nature of the work and the diameter of the drill, comprising, in combination, a drill spindle, a driving shaft and power means for rotating the latter, means for operatively connecting said spindle and shaft whereby the spindle may be rotated at variable speeds, said means consisting of a pair of conical pulley discs having intermeshing recesses and protuberances and operatively connected with said spindle, a corresponding pair of similar discs operatively connected with said shaft and arranged with their axis parallel to the axis of the first named pair, alternately opposite discs of the pairs being respectively fixed and movable axially, a relatively narrow wedge belt trained over and directly connecting the pairs of pulley discs to transmit rotation from the one to the other, the mean width of said belt being not substantially greater than the thickness thereof, a two-armed bracket disposed between the pairs of discs and connected to said alternately disposed axially movable discs, means for shifting said bracket in a direction parallel to the axes of the discs, whereby the discs of each pair are relatively shifted in opposite directions, said shifting means comprising a rotatable shaft on said drilling machine provided with a pinion, a rack on said bracket meshing with said pinion whereby rotation of said shaft may effect the shifting of said bracket and said discs, and means for locking said handle in adjusted positions.

WILLY SCHÜBBE. 50