Feb. 28, 1939. H. MOLLY 2,148,956

METHOD OF AND MEANS FOR TRUING GRINDING DISKS

Filed Aug. 3, 1935 4 Sheets-Sheet 1

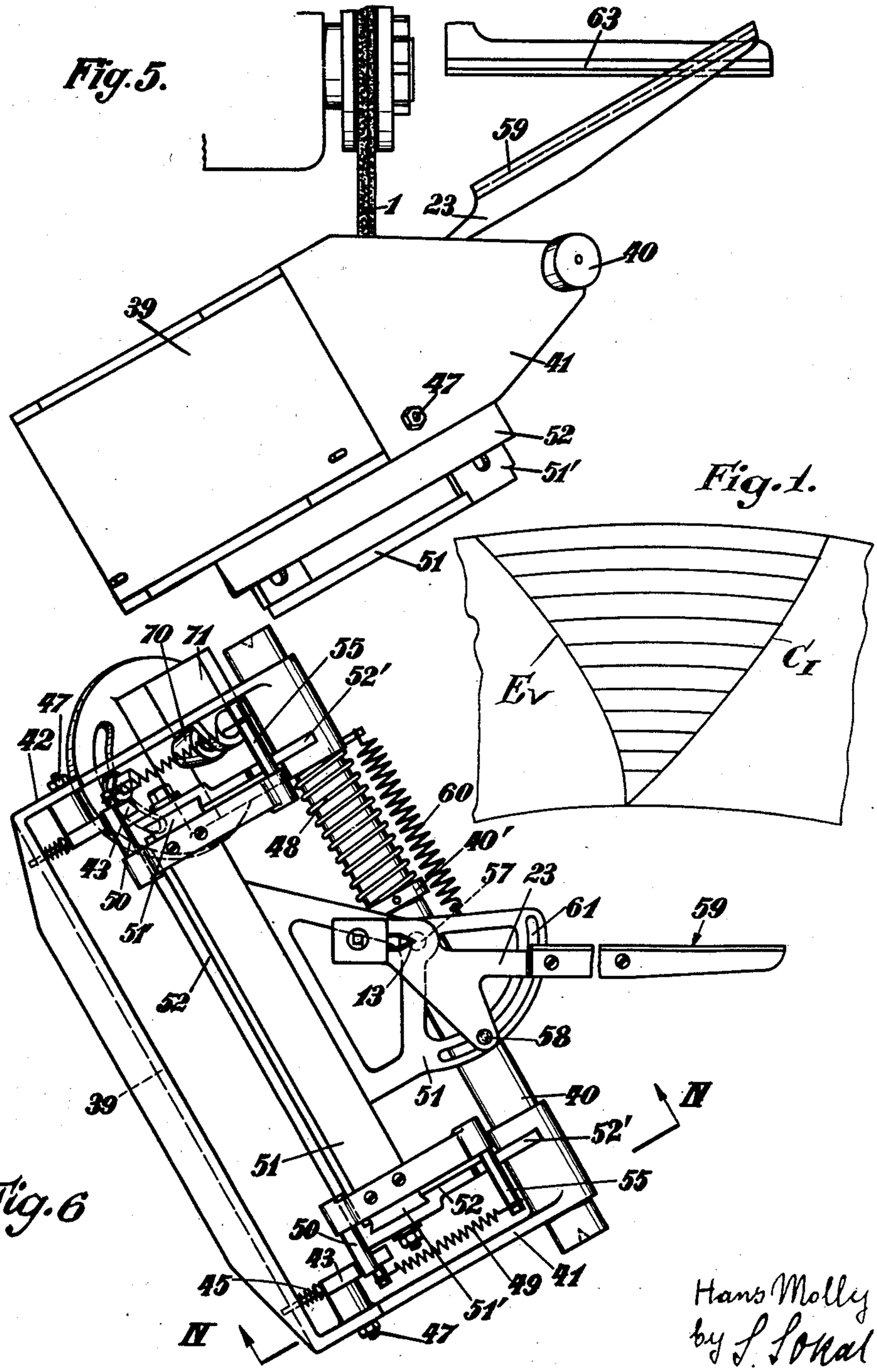

Fig. 5.

Fig. 6

Fig. 1.

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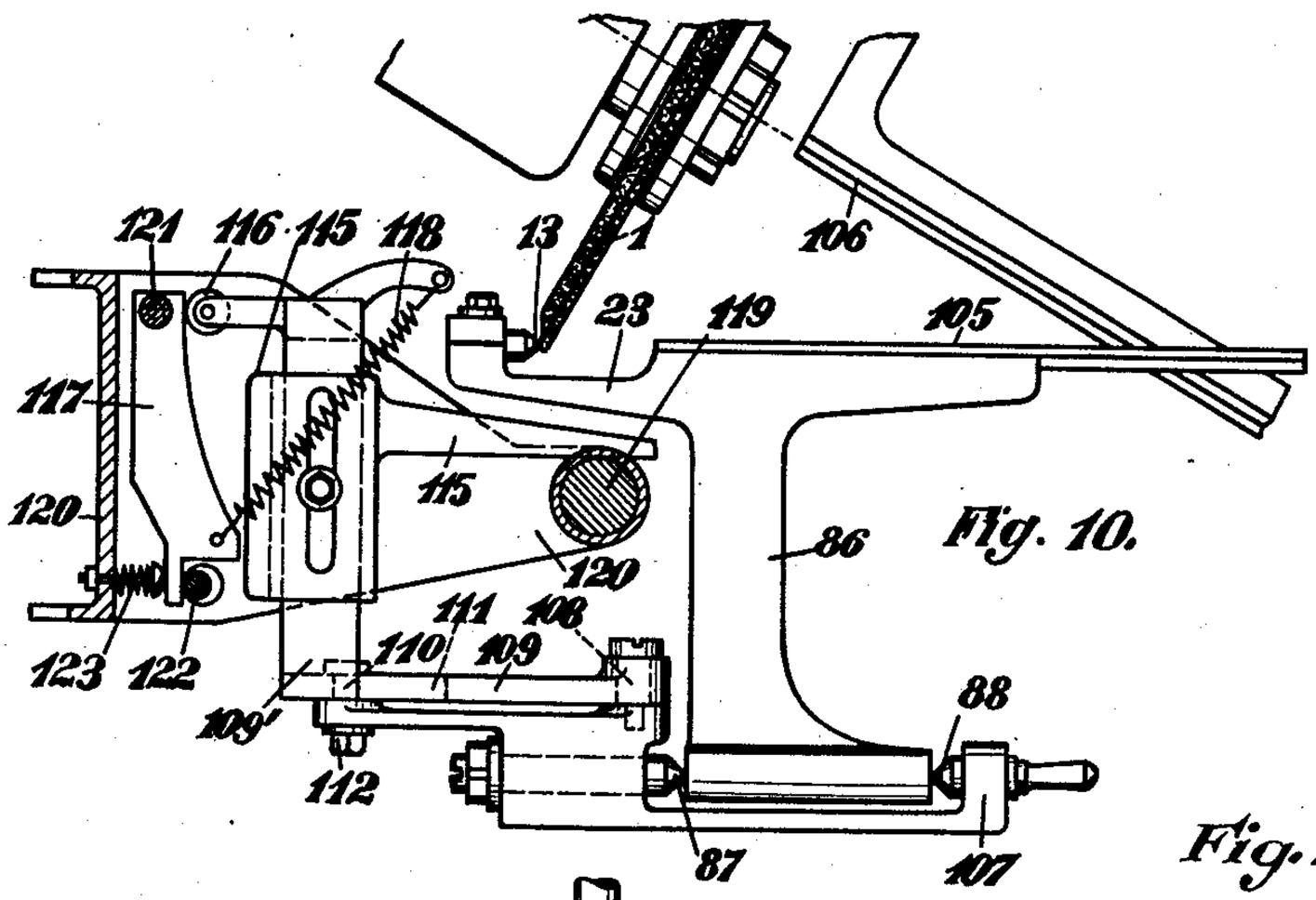
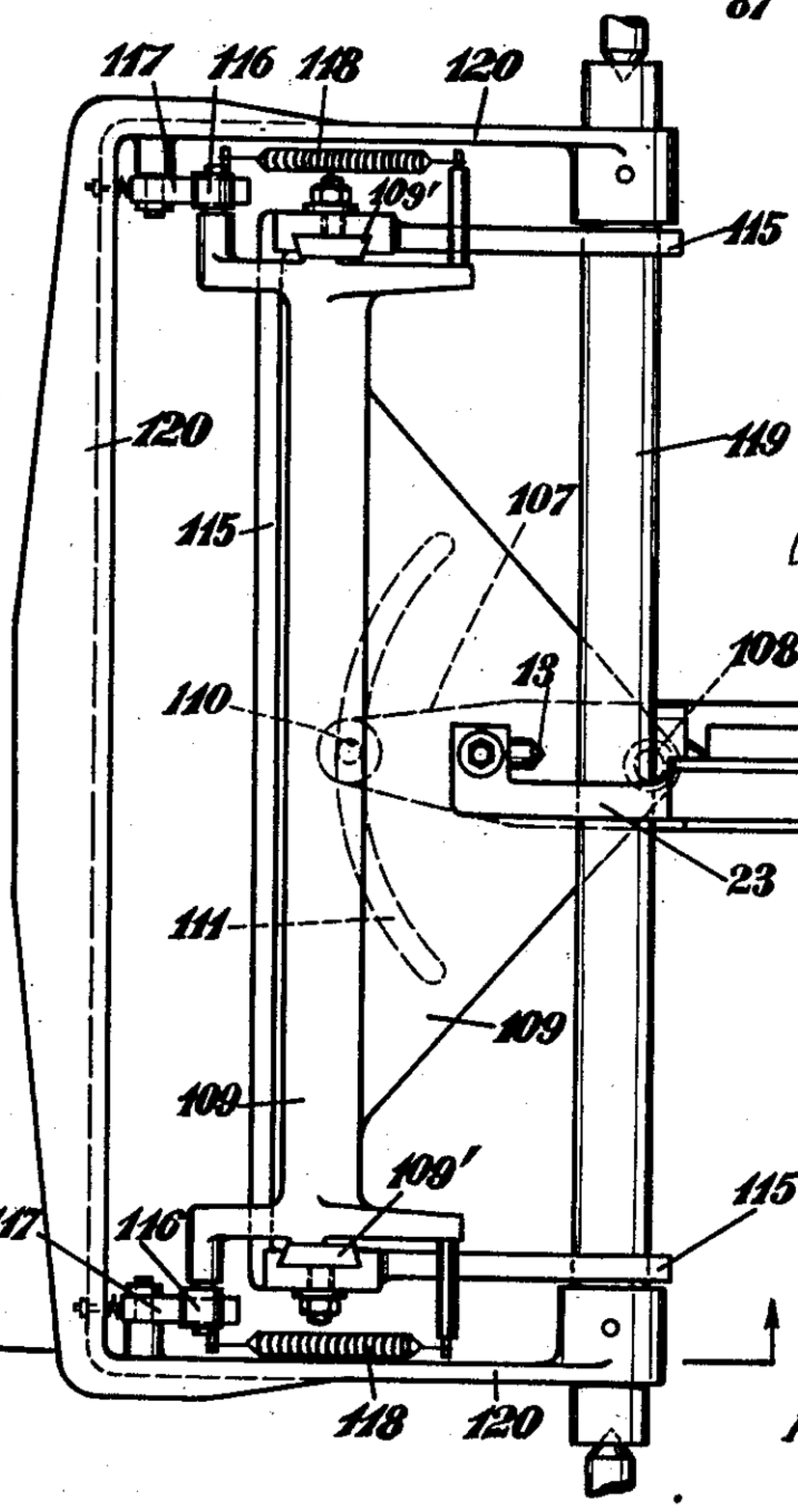


Fig. 10.

Fig. 2.



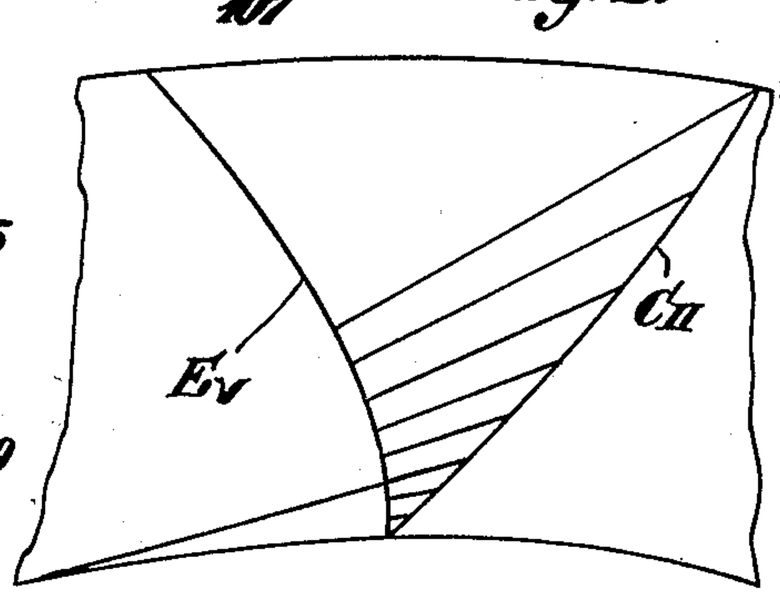


Fig. 11

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METHOD OF AND MEANS FOR TRUING GRINDING DISKS

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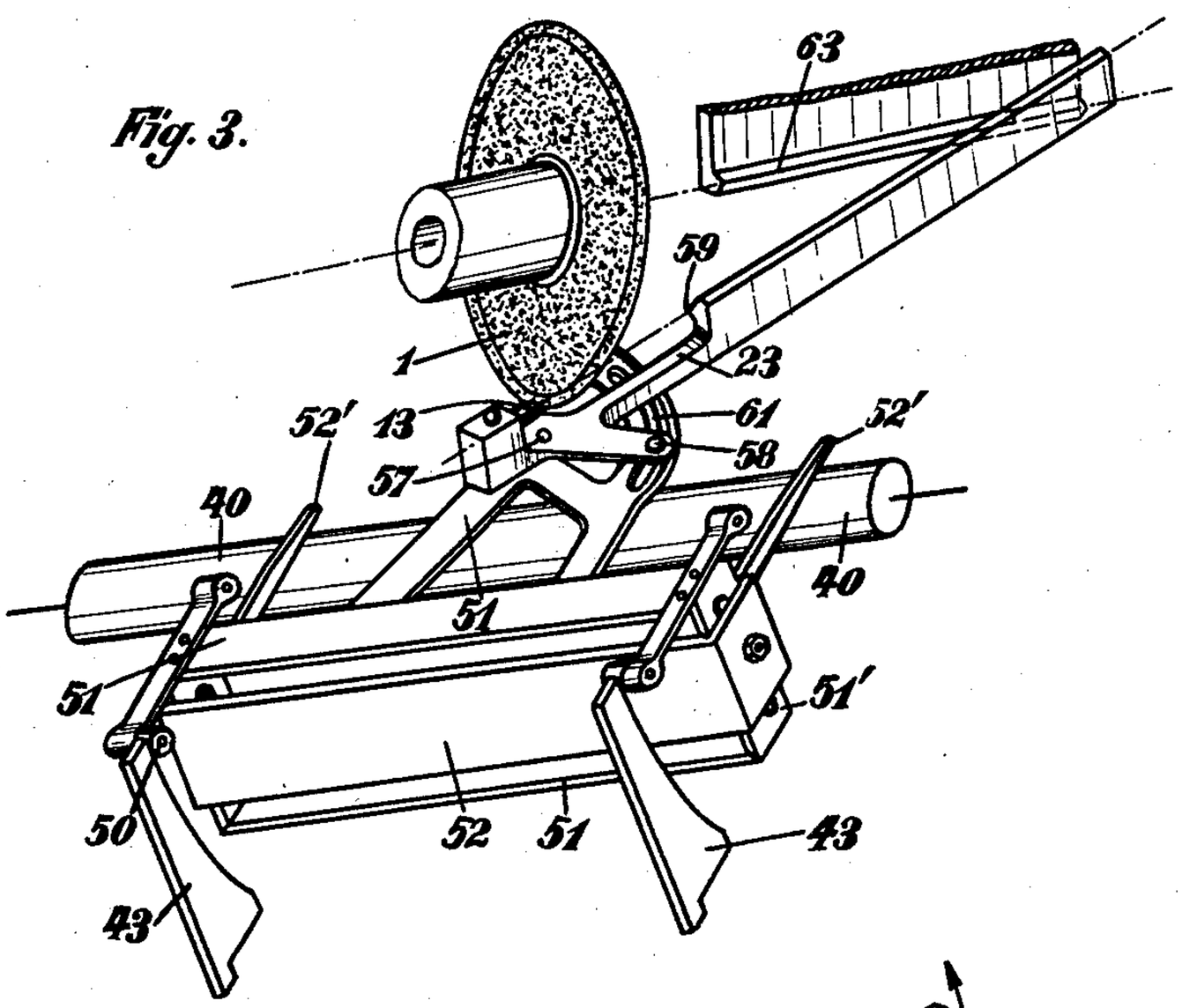
Fig. 3.



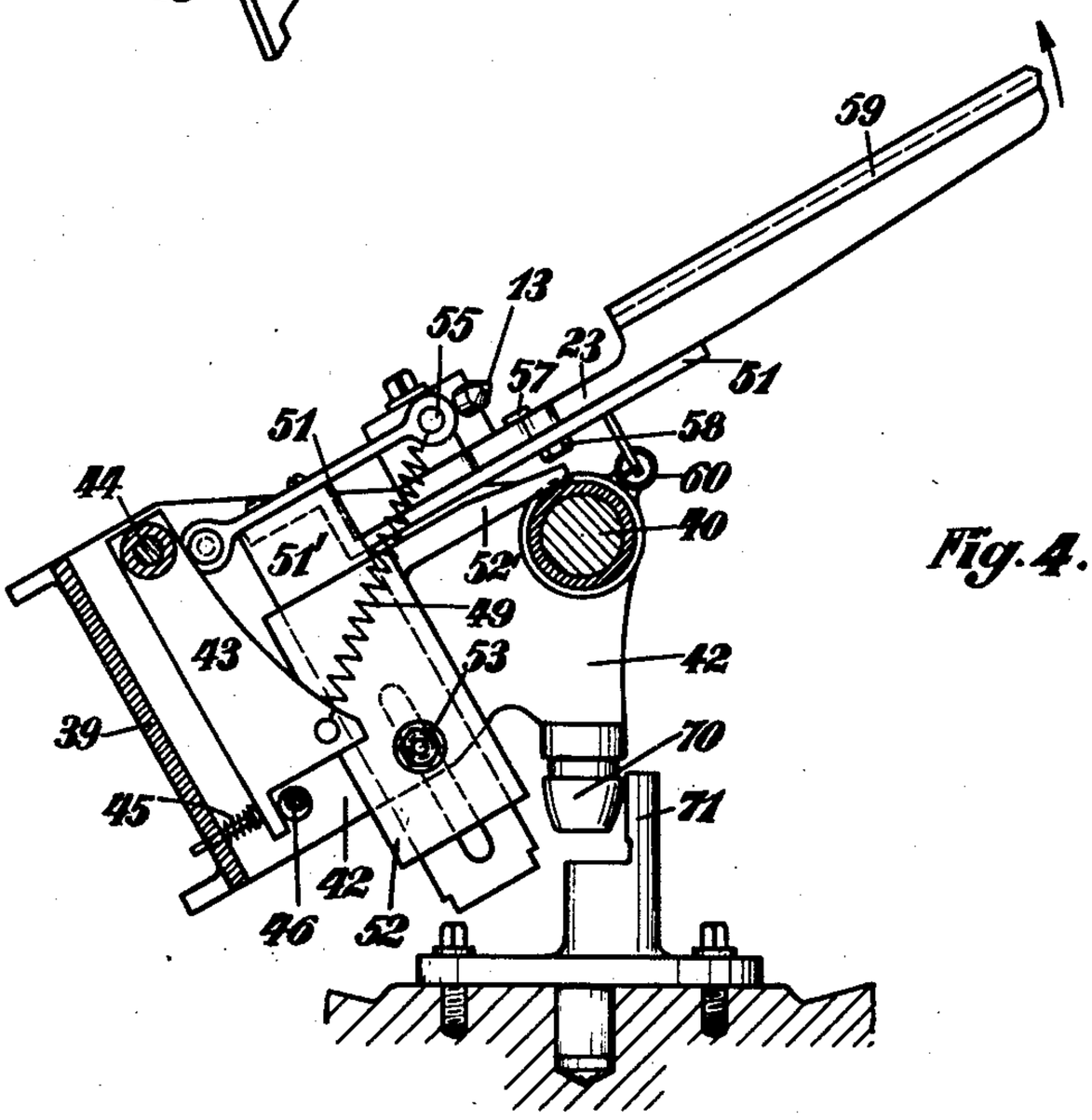


Fig. 4.

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METHOD OF AND MEANS FOR TRUING GRINDING DISKS

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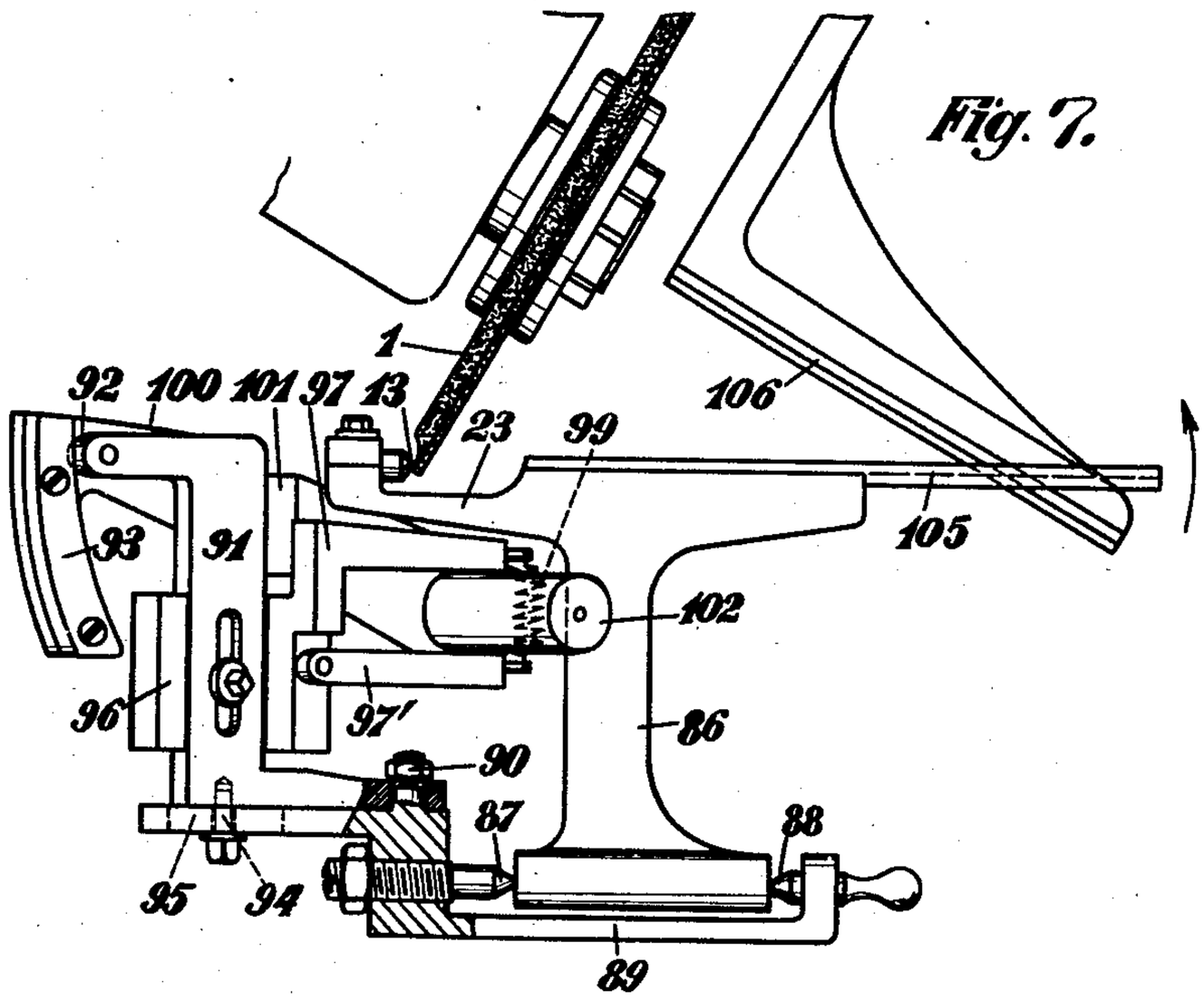

Fig. 7.

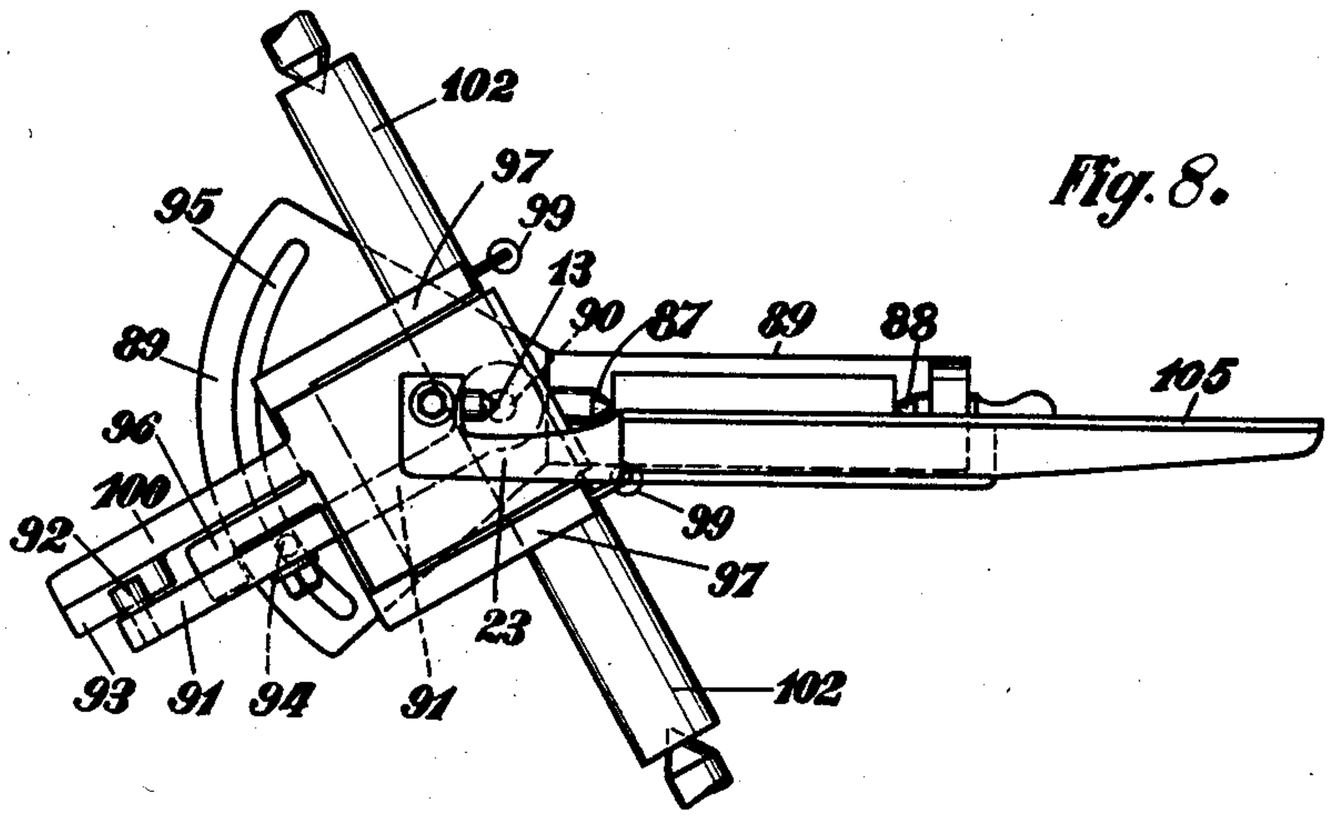

Fig. 8.

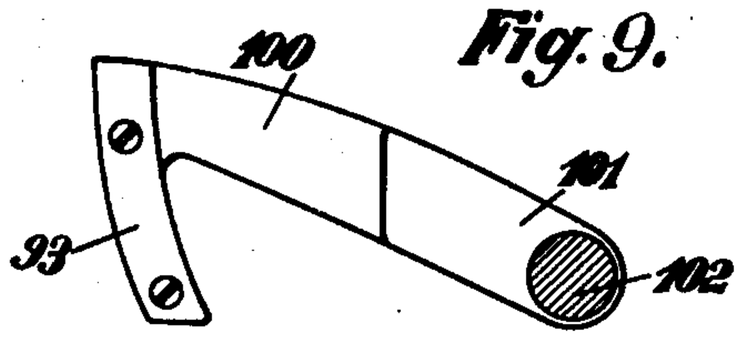

Fig. 9.

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UNITED STATES PATENT OFFICE

2,148,956

METHOD OF AND MEANS FOR TRUING GRINDING DISKS

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Application August 3, 1935, Serial No. 34,541
In Germany August 13, 1934

12 Claims. (Cl. 125—11)

An application has been filed in Germany August 13, 1934.

For truing or dressing the working surface of profiled grinding disks for grinding toothed gears with helical teeth having involute profiles, the truing tool (for instance a diamond) is, according to my prior patent application Ser. No. 758,412, filed on December 20, 1934, always guided during the truing upon a curved path which corresponds to the line of contact between the grinding disk and the gear tooth to be ground. This line of contact may be shortly termed "grinding line".

For moving of the truing or dressing tool upon the grinding line it is necessary to guide the tool on the imaginary side face of the tooth in such a manner that the normals to the said side face in which the working point of the tool is located at any given time are directed towards the axis of the grinding disk and intersect this axis. The said normals which are lying in planes radial to the grinding disk represent the lines of shortest distance between the side face of the imaginary tooth and their point of intersection with the axis of the grinding disk. The initial and terminal points of these shortest normals on the side face of the imaginary tooth are the points of contact of the operative surface of the grinding disk. All the possible starting points of the normals on the side face of the tooth, which intersect the axis of the grinding disk, form together the so-called grinding line.

The present invention relates to improvements of the truing method referred to consisting in, whilst using the essential features of my prior patent application Ser. No. 758,412, modifications of the truing method disclosed therein.

For the purpose of moving the truing or dressing tool upon the imaginary side face of the tooth the present invention provides two new solutions of the method.

One solution consists in that the truing tool is guided along the real side involute (as it appears at the sides of the toothed wheel to be ground) and is simultaneously displaced progressively along a screw path leading around the longitudinal axis of the imaginary toothed gear to be ground.

The other solution consists in that the truing tool is guided along the real side involute and simultaneously along an imaginary straight line which is similarly directed to the straight lines of simultaneous engagement of co-operating gear wheel teeth. In this case the movement of the tool along said imaginary straight line is performed for instance by means of a swingably mounted tool carrier.

In all cases by suitable coupling members which lead from the shaft of the grinding disk to the tool carrier, the tool is always held in such a manner that the normals on the side face of an imaginary gear tooth which pass through the working point of the truing tool will intersect the axis of the grinding disk.

The devices operating according to the method may, for truing or dressing the grinding disk, be constructed either as suitable for insertion into the grinding machine at the point at which otherwise the gear to be ground is placed, or they may be constructed as a separate truing or dressing device into which the grinding disks to be trued are to be inserted.

It will, however, be always found most advantageous to provide upon each grinding machine a truing or dressing device in such manner that the latter can, without re-setting the grinding disk be always brought into action. For instance, the truing device is so constructed that it can be easily inserted into the machine or it is foldably connected with the machine.

In the drawings Figs. 1 and 2 are partial developments of tooth side faces of a gear with helical teeth, showing co-ordinate systems with the grinding line constituting the imaginary curved path along which the truing or dressing tool is to be moved for the purpose of operating on the working surface of the grinding disk. In Fig. 1 the grinding line is indicated by C I and in Fig. 2 by C II. In Fig. 1 the screw lines running parallel to the tooth edges are drawn and appear like the tooth edges as circular arcs in the development. Fig. 2 shows the lines of simultaneous engagement of two co-operating gears with helical teeth. These lines constitute each a straight line which is tangent to the lower limiting line of the developed tooth flank.

A constructional form of a device which works in accordance with the plan of Fig. 1 is shown by way of example in Figs. 3 to 6.

Fig. 3 shows diagrammatically and in perspective view the essential parts of the device together with the grinding disk to be trued.

Fig. 4 is a section on line IV—IV (Fig. 6).

Fig. 5 is a side view at right angles to the axis of the grinding disk.

Fig. 6 shows the device seen from above.

The constructional forms given by way of example and illustrated in the following figures, correspond as regards their action to the plan of Fig. 2.

Fig. 7 shows a constructional form in side view at right angles to the grinding disk shown.

Fig. 8 shows the same constructional form seen from above.

Fig. 9 illustrates an appertaining detail seen from the side.

Fig. 10 shows a further constructional form in side view towards the grinding disk shown, in which for the purpose of clearer representation, the truing tool is not set at the screw angle, but at the usual inoperative right angle cross position with regard to the longitudinal axis of the oblique teeth gear to be ground. One cross wall of the casing of the device is cut away.

Fig. 11 shows the device seen from above, the truing tool again assuming the referred to cross position.

In all the figures the grinding disk is designated by 1 and the tool serving for truing the grinding disk, for instance, a diamond, by 13. The carrier of the truing tool is designated by 23.

The most essential parts of the truing device consist of:

(*a*) Means for producing an involute movement of the truing tool.

(*b*) Means for producing a rectilineal movement in the direction of the line of simultaneous engagement between co-operating helical teeth.

(*c*) Means by which the truing device is screwed if required in the same manner as the gear to be ground.

(*d*) Means for guiding the truing tool at the axis of a grinding disk.

For producing the involute movement of the truing tool, templets may be used as shown by the illustrated examples. Constructions are, however, also possible in which by means of a link system, the movement of the truing tool is effected without the use of a templet.

The means mentioned under *c* are, for instance, in Figs. 3 to 6 chosen by way of example in a construction which is independent of the screwing device for the helical teeth gear to be ground usually already present in the grinding machine.

In the device according to Figs. 3 to 6, the main carrier is the shaft 40 which is fixed between centre points of the machine. Upon the shaft 40 rests a casing which contains the longitudinal side 39 and the cross sides 41 and 42. Upon these sides are adjustably mounted the involute templets 43. At the top the templets are swingably held by means of bolts 44 and below they are pressed by springs 45 against stop blocks 46 which latter form bolts thickened at one side, which are adjustable by turning and fixable by means of nuts 47.

Upon the templets 43 bears by means of pins 50 or the like a frame 51 which by means of lateral bars 51' is adjustably held in a yoke-shaped part 52. The fixing of the frame 51 in the yoke 52 is rendered possible by means of a bolt 53 mounted in the yoke. The yoke 52 rests by means of arms 52' upon the shaft 40 or upon the hubs of the transverse sides 41 and 42. Contact is obtained by the action of the tension springs 49 which are connected at one end to bolts 55 of the frame 51 and at the other end to the templets 43. The springs 49 therefore hold the frame 51 with the pins 50 against the templets 43 and simultaneously also the arms 52' against the shaft 40. The shaft 40 has at a suitable point a fixed collar 40' against which rests a pressure spring 48, the latter acting with its other end against the hub of the transverse side 42 and thereby holds the casing 39, 41, 42 in its normal position of rest.

The tool holder 23 is held turnably about a bolt 57 upon frame 51, and can be set by means of a setscrew 58 guided in a circular slot 61, at the required angular position with regard to the longitudinal axis of the gear to be ground, that is, at the correct screw angle. The coupling of the truing tool 13 or the tool carrier 23 with the grinding disk shaft is obtained by means of knife bars. One knife bar 59 which is fixed to the tool carrier 23 stands with its knife edge exactly in the axis of the truing tool 13 and bears against the counter edge of bar 63, the latter edge lying exactly in the axis of the grinding disk. The frame 51 is pulled with its bolt 55 by a spring 60 against the transverse wall 42, and a second, but weaker spring 48, which rests against collar 40', acts upon casing 39, 41, 42 in axial direction, so that knife bar 59 is pressed against knife bar 63. For the purpose of producing the screw motion of the truing tool, a guide pin 70 is provided upon the casing member 42, said guide pin bearing against a bar 71 adapted to be set upon the machine bed in accordance with the screw angle. The peripheral surface of the guide pin is in the shape of an involute.

The entire device is preferably positioned at such an angle with regard to the grinding disk axis that the axis of the truing tool at the root point of the involute stands at the greatest possible angle of inclination with regard to the grinding disk axis, as far as this is permitted by the gap interval between the flank to be ground and the opposite flank for the grinding disk. By this means, advantageous structural conditions are obtained, inasmuch as the guide knife bars 59 and 63 may be comparatively short.

The truing of the grinding disk is effected by simultaneously a lateral and a swinging movement of the tool 13 with the tool carrier 23 and frame 51 and yoke 52 in the direction indicated by arrow in Fig. 4, the casing 39, 41 and 42 with the pin 70 bearing against the stationary ruler 71 and forming during the swinging of the tool carrier a screw motion.

In the constructional form of a truing device working according to the scheme of Fig. 2 shown in Figs. 7 to 9, in which the screw motion of the truing tool is omitted, the truing tool is within certain limits laterally movable, for instance by mounting the truing tool holder 23 upon a swing arm 86 which is mounted between centre points 87 and 88 of a holding member 89. The holding member 89 projects with a pin 90 into the lower projection of a bar 91 which has at the top a pin 92 bearing against an involute templet 93. The bar 91 projects with a pin 94 through a circular arc slot 95 extending round the pivot 90, and thus permits the required setting of the truing tool 13 or the truing tool carrier 23 at the angle required at the time being. The bar 91 is mounted vertically adjustably in a yoke 96 which together with two oppositely arranged bars 97, 97' engages the shaft 102, good contact being provided by tension springs 99.

The truing of the grinding disk is effected by swinging the whole device in the direction of the arrow of Fig. 7, so that the truing tool 13 performs by the intermediary of the guide along the involute templet, the correct involute movement upon the profile surface of the grinding disk. During this movement, the truing tool receives simultaneously a rectilineal movement in the direction of a line of simultaneous engagement of two co-operating gears having helical teeth. By making the swing arm 86 as large as possible, the

movement of the truing tool in the direction of the line of engagement which is in itself short, becomes almost a straight line, which does not impair the accuracy of the truing operation. The involute templet 93 is preferably fixed adjustably, and if required, also exchangeably upon an arm 100 of the block 101, the block 101 being combined with the shaft 102 which latter is inserted between the centre points into the grinding machine in place of the gear to be ground.

With the tool carrier 23 is connected the knife bar 105 which bears against the knife bar 106 provided upon the machine in the prolongation of the grinding disk axis. The knife bar 106 must be mounted swingably and exchangeably upon the grinding machine.

A further constructional form working according to the scheme of Fig. 2 is shown in Figs. 10 and 11. In this case the tool carrier 23 is again fixed upon an arm 86 which is mounted between centre points 87 and 88 in a holding member 107. The latter is adapted to be swung about a bolt 108 at the under side of a frame 109, and projects by means of a bolt 110 into a circular arc slot 111 of the frame 109 extending around the bolt 108. This construction enables the tool holder 23 or the truing tool to be set at the angle required at the time being. In the various adjusted positions, the tool holder may be fixed by tightening the nut 112 of the bolt 110. The frame 109 is guided by means of bars 109' in a yoke 115 and is adjustable and fixable in the vertical direction in accordance with the pitch circle distance. At the top of the frame 109 are provided arms upon which are mounted rollers 116 or sliding bolts which are adapted to bear against the involute templets 117. Moreover, the frame 109 is by means of two tension springs 118 connected with the templets 117 so that the rollers 116 bear against the templets 117 and simultaneously the yoke 115 bears upon the shaft 119 with which latter the casing 120 is connected.

The coupling of the tool carrier 23 with the grinding disk shaft may again be obtained as in previously described constructional examples by knife bars 105 and 106.

The templets are suitably suspended swingably by means of bolts 121 and are adjustable at the lower ends by bolts 122 thickened at one side into the required positions. Springs 123 press the templets against the bolt 122.

I claim:

1. In a device for truing profiled grinding disk for grinding tooth side faces of gears having helical teeth, the combination of: a truing tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, and means for guiding said tool at the axis of said grinding disk in such a manner that the axis of said tool is directed at all working points substantially normally to the profile surface of said grinding disk; and knife bars associated with said truing tool and said grinding disk, the edges of said knife bars constituting the prolongation of the grinding disk axis and the prolongation of the axis of the truing tool respectively and guiding each other by bearing against each other so that the axes intersect, substantially as described.

2. In a device for truing profiled grinding disks for grinding tooth side faces of gears having helical teeth, the combination of: a truing tool; means for guiding said truing tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground; means for coupling said truing tool with the shaft of said grinding disk in such manner that the axis of said truing tool is directed at all working points substantially normally to the profile surface of said grinding disk; and means for guiding said tool along lines of simultaneous engagement of two co-operating gears with helical teeth, comprising an arm swingable in the direction of such lines of simultaneous engagement.

3. In a device for truing profiled grinding disks for grinding tooth side faces of gears having helical teeth, the combination of: a truing tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground; means for guiding said tool at the axis of said grinding disk in such a manner that the axis of said tool is directed at all working points normally to the profile surface of said grinding disk; and means provided on the frame of the truing device for producing a screw movement of said tool, said last named means including a pin having an involute shaped surface, and a stationary ruler rigidly mounted in the casing of the truing device upon which ruler said pin bears, said ruler being adjustable in accordance with the screw angle.

4. In a device for truing profiled grinding disks for grinding tooth side faces of gear having helical teeth, the combination of: a truing tool; a tool carrier for said tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, said means including two involute templets arranged one on each side of the axis of the tool, and pins cooperating with said templets and said tool carrier to guide the latter; and means for guiding said tool at the axis of said grinding disk in such a manner that the axis of said tool is directed at all working points normally to the profile surface of said grinding disk.

5. In a device for truing profiled grinding disks for grinding tooth side faces of gear having helical teeth, the combination of: a truing tool; a tool carrier for said tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, said means including a casing, two involute templets carried by said casing and arranged one on each side of the axis of the tool, a shaft upon which said casing rests and which shaft is adapted to be clamped between centre points of the grinding machine, and parts resting on the one hand upon the templets and on the other hand upon said shaft, said tool carrier being swingable and fixable at the adjusted angle upon said parts; and means for guiding said tool at the axis of said grinding disk in such manner that the axis of said tool is directed at all working points substantially normally to the profile surface of said grinding disk.

6. In a device for truing profiled grinding disks for grinding tooth side faces of gear having helical teeth, the combination of: a truing tool; a tool carrier for said tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, said means including a casing, two involute templets carried by said casing and arranged one on each side of the axis of the tool, a shaft upon which said

casing rests and which shaft is adapted to be clamped between centre points of the grinding machine, and parts resting on the one hand upon the templets and on the other hand upon said shaft, said tool carrier being swingable and fixable at the adjusted angle upon said parts; and means for guiding said tool at the axis of said grinding disk in such a manner that the axis of said tool is directed at all working points normally to the profile surface of said grinding disk; and said casing, carrying the involute templets, being, together with the parts carrying the truing tool, longitudinally slidable and also swingable upon said shaft.

7. In a device for truing profiled grinding disks for grinding tooth side faces of gear having helical teeth, the combination of: a truing tool; a tool carrier for said tool; means for guiding said tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, said means including a casing, two involute templets carried by said casing and arranged one on each side of the axis of the tool; a shaft upon which said casing rests and which shaft is adapted to be clamped between centre points of the grinding machine, and parts resting on the one hand upon the templets and on the other hand upon said shaft; a pivot pin located in a vertical plane upon which said tool carrier is mounted so as to be swingable; a frame carrying said pivot pin; a yoke in which said frame is guided in same direction as said pivot pin for adjustment in accordance with the pitch circle cylinder radius; arms on said yoke bearing on said shaft; and means for guiding said truing tool at the axis of said grinding disk in such a manner that the axis of said truing tool is directed at all working points substantially normally to the profile surface of said grinding disk.

8. In a device for truing profiled grinding disks for grinding tooth side faces of gears having helical teeth, the combination of: a truing tool; a tool carrier for said tool; means for guiding said truing tool along a path corresponding to the front involute of the side flanks of the teeth at the sides of the toothed wheel to be ground, said means including two adjustably mounted involute templets arranged one on each side of the axis of the tool, and pins co-operating with said templets and said tool carrier to guide the latter; and means for guiding said tool at the axis of said grinding disk in such manner that the axis of said truing tool is directed at all working points normally to the profile surface of said grinding disk.

9. An improvement in the method of truing a profiled rotating disk for grinding gears with helical teeth having side faces of the shape of an involute, whereby the truing tool is to be moved upon a curved path corresponding to the line of engagement between the grinding disk and the side face of the tooth to be ground, and whereby the tool is always held in such a manner that the normals on the side face of an imaginary gear tooth passing through the working point of the tool will intersect the axis of the grinding disk, consisting in guiding the said truing tool along the front involute (as it appears at the sides of the toothed wheel to be ground); simultaneously displacing said tool progressively along a screw path leading around the longitudinal axis of the imaginary toothed gear to be ground.

10. An improvement in the method of truing a profiled rotating disk for grinding gears with helical teeth having side faces of the shape of an involute, whereby the truing tool is to be moved upon a curved path corresponding to the line of engagement between the grinding disk and the side face of the tooth to be ground, and whereby the tool is always held in such a manner that the normals on the side face of an imaginary gear tooth passing through the working point of the tool will intersect the axis of the grinding disk, consisting in guiding the tool along the front involute (as it appears at the sides of the toothed wheel to be ground) and simultaneously guiding the said tool along an imaginary straight line which is similarly directed to the straight lines of simultaneous engagement of co-operating gear wheel teeth.

11. An improvement in the method of truing a profiled rotating disk for grinding gears with helical teeth having side faces of the shape of an involute, whereby the truing tool is to be moved upon a curved path corresponding to the line of engagement between the grinding disk and the side face of the tooth to be ground, and whereby the tool is always held in such a manner that the normals on the side face of an imaginary gear tooth passing through the working point of the tool will intersect the axis of the grinding disk, consisting in guiding the said truing tool along the front involute (as it appears at the sides of the toothed wheel to be ground); simultaneously displacing said tool progressively along a screw path leading around the longitudinal axis of the imaginary toothed gear to be ground, and guiding said tool in such manner that the axis thereof is directed at all working points normally to the profile surface of the grinding disk, and holding the tool at its position at the root point of the involute so inclined with regard to the grinding disc axis that the axis of the tool is located at the greatest possible inclination to the axis of the grinding disk as is permitted (for the grinding disc) by the gap space between the side face of the tooth to be ground and the opposite tooth side face.

12. An improvement in the method of truing a profiled rotating disk for grinding gears with helical teeth having side faces of the shape of an involute, whereby the truing tool is to be moved upon a curved path corresponding to the line of engagement between the grinding disk and the side face of the tooth to be ground, and whereby the tool is always held in such a manner that the normals on the side face of an imaginary gear tooth passing through the working point of the tool will intersect the axis of the grinding disk, consisting in guiding the tool along the front involute (as it appears at the sides of the toothed wheel to be ground); simultaneously guiding the said tool along an imaginary straight line which is similarly directed to the straight line of simultaneous engagement of co-operating gear wheel teeth, and guiding said tool in such manner that the axis thereof is directed at all working points normally to the profile surface of the grinding disk, and holding the tool at its position at the root point of the involute so inclined with regard to the grinding disk axis that the axis of the tool is located at the greatest possible inclination to the axis of the grinding disk as is permitted (for the grinding disk) by the gap space between the side face of the tooth to be ground and the opposite tooth side face.

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