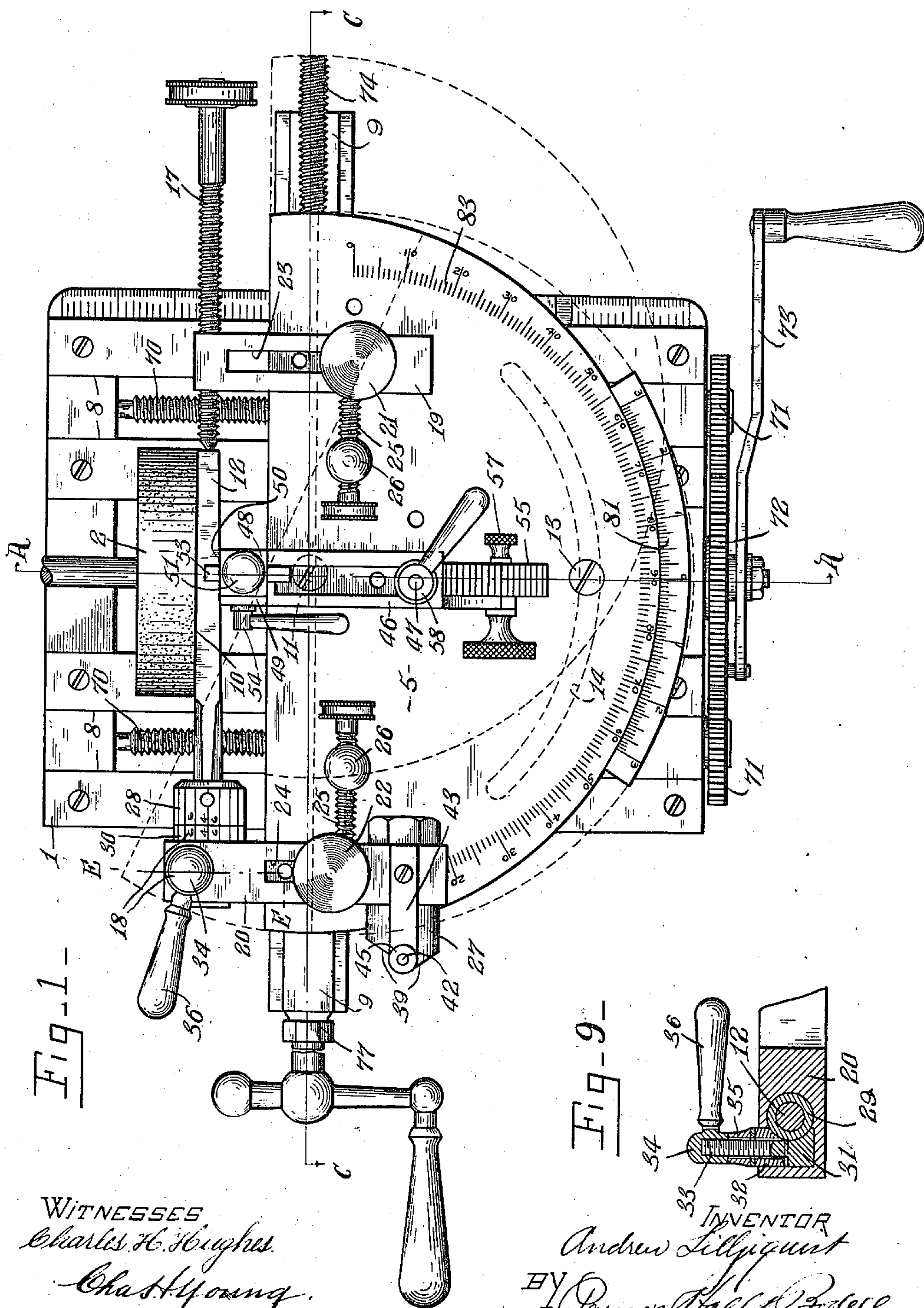


A. LILLJQUIST.  
GRINDING MACHINE.  
APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS-SHEET 1.



WITNESSES  
Charles H. Hughes.  
Chas. Young.

Fig. 9-  
INVENTOR  
Andrew Lilljquist  
BY Parsons, Peck & Peck  
ATTORNEYS

A. LILLJQUIST.  
GRINDING MACHINE.

APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS—SHEET 2.

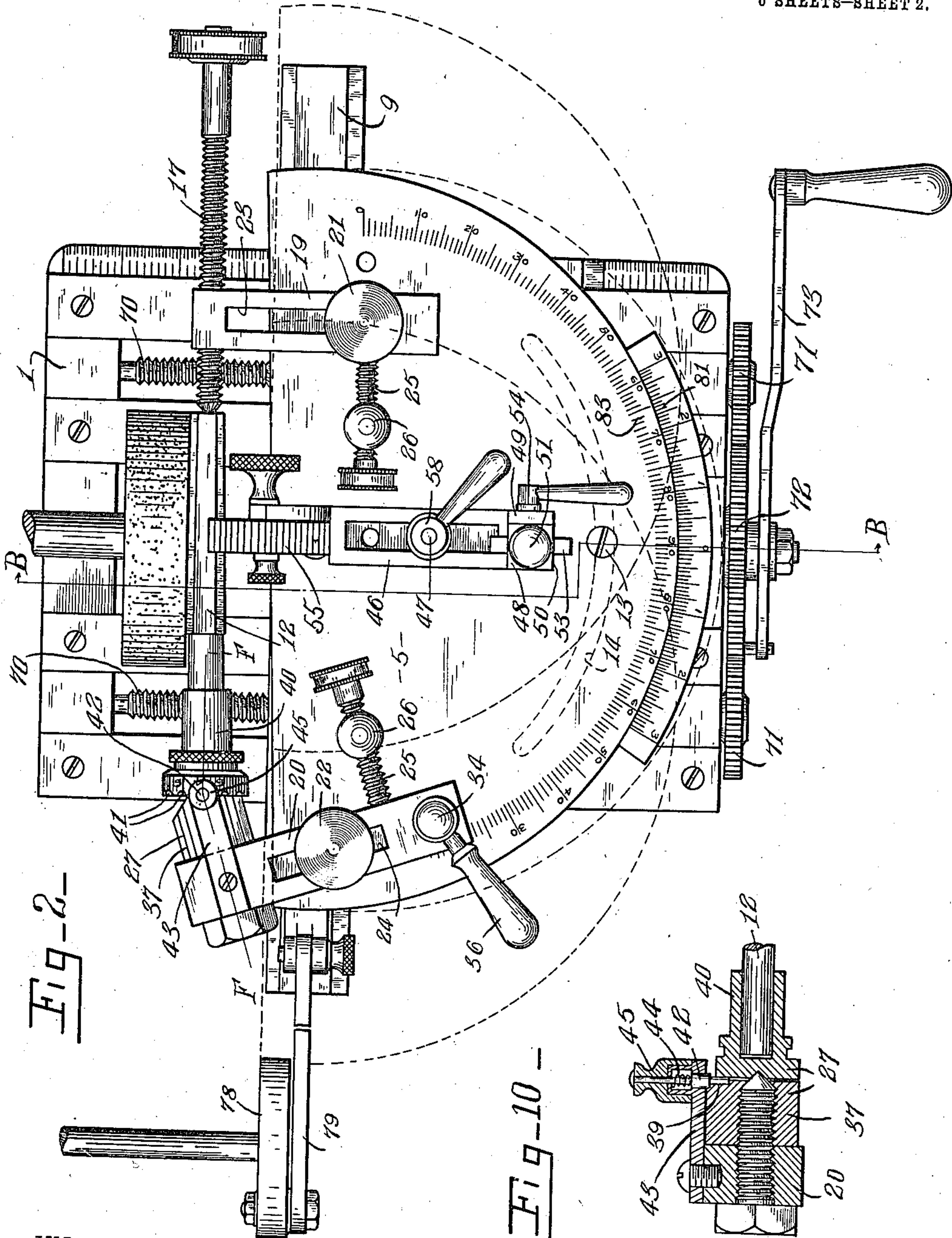


Fig-2-

Fig-10-

WITNESSES  
Charles H. Hughes.  
Chas. H. Young.

INVENTOR  
Andrew Lilljquist  
BY Carson Hall Bodeel  
ATTORNEYS



A. LILLJIQUIST.  
GRINDING MACHINE.  
APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS-SHEET 3.

Fig. 3-

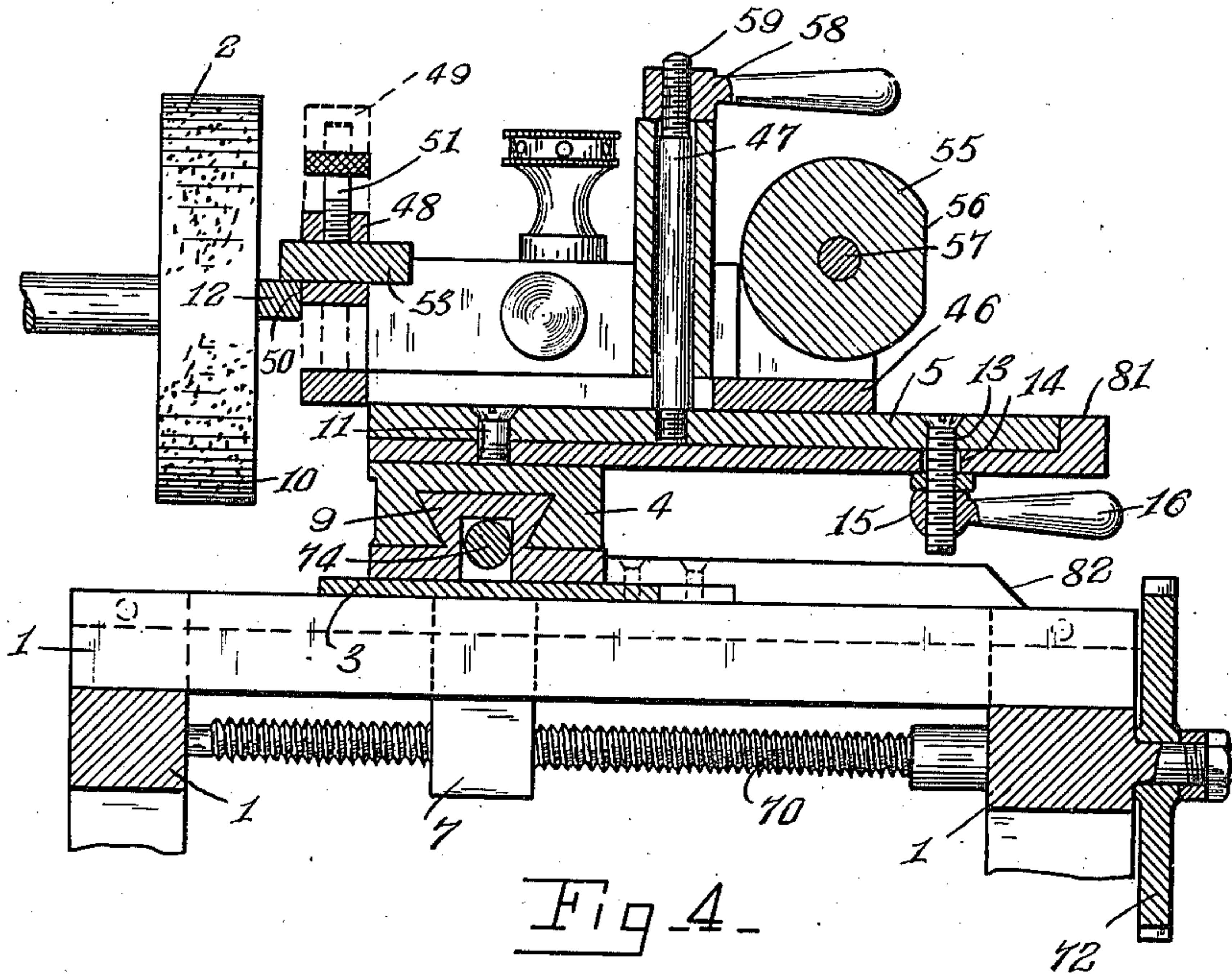
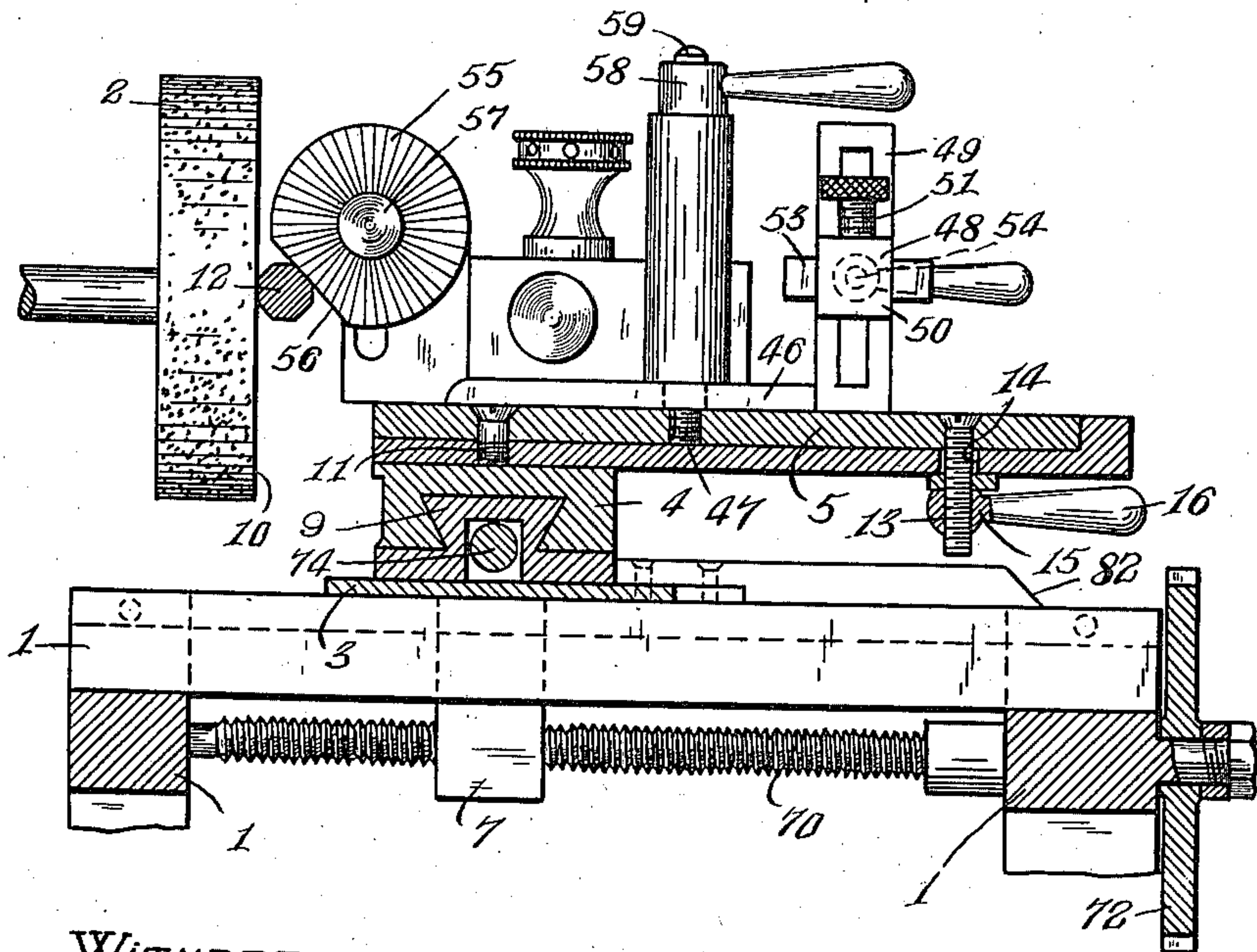


Fig. 4-



WITNESSES  
Charles H. Hughes.  
Chas. H. Young.

INVENTOR  
Andrew Lilljquist  
BY Parsons Hall Rodee  
ATTORNEYS

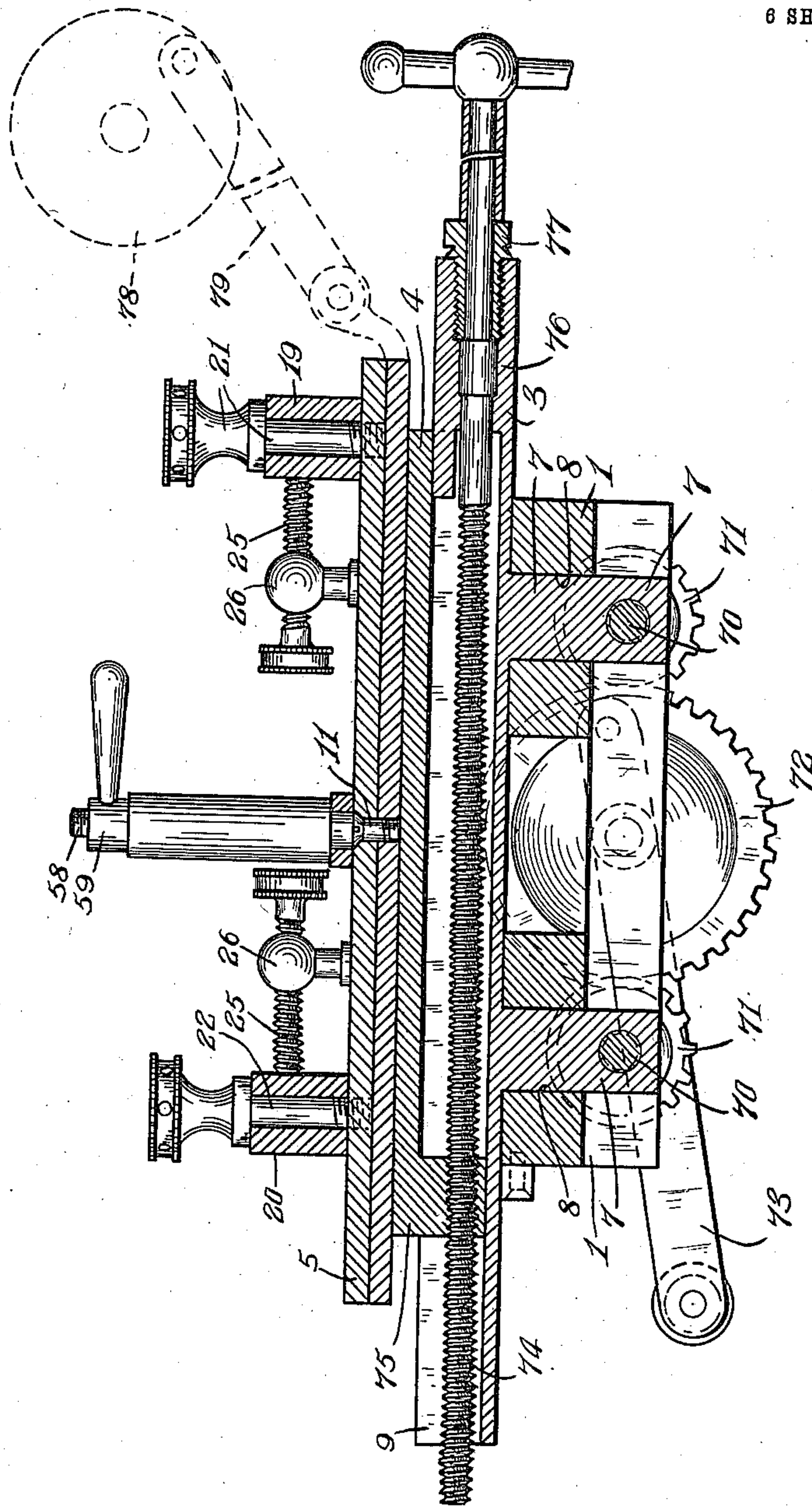
A. LILLJQUIST.  
GRINDING MACHINE.  
APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS—SHEET 4.

Fig-5-



WITNESSES  
Charles H. Hughes  
Chas. Young.

INVENTOR  
Andrew Lilljquist  
BY *Parsons Hall Breda*  
ATTORNEYS



A. LILLJQUIST.  
GRINDING MACHINE.  
APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS-SHEET 5.

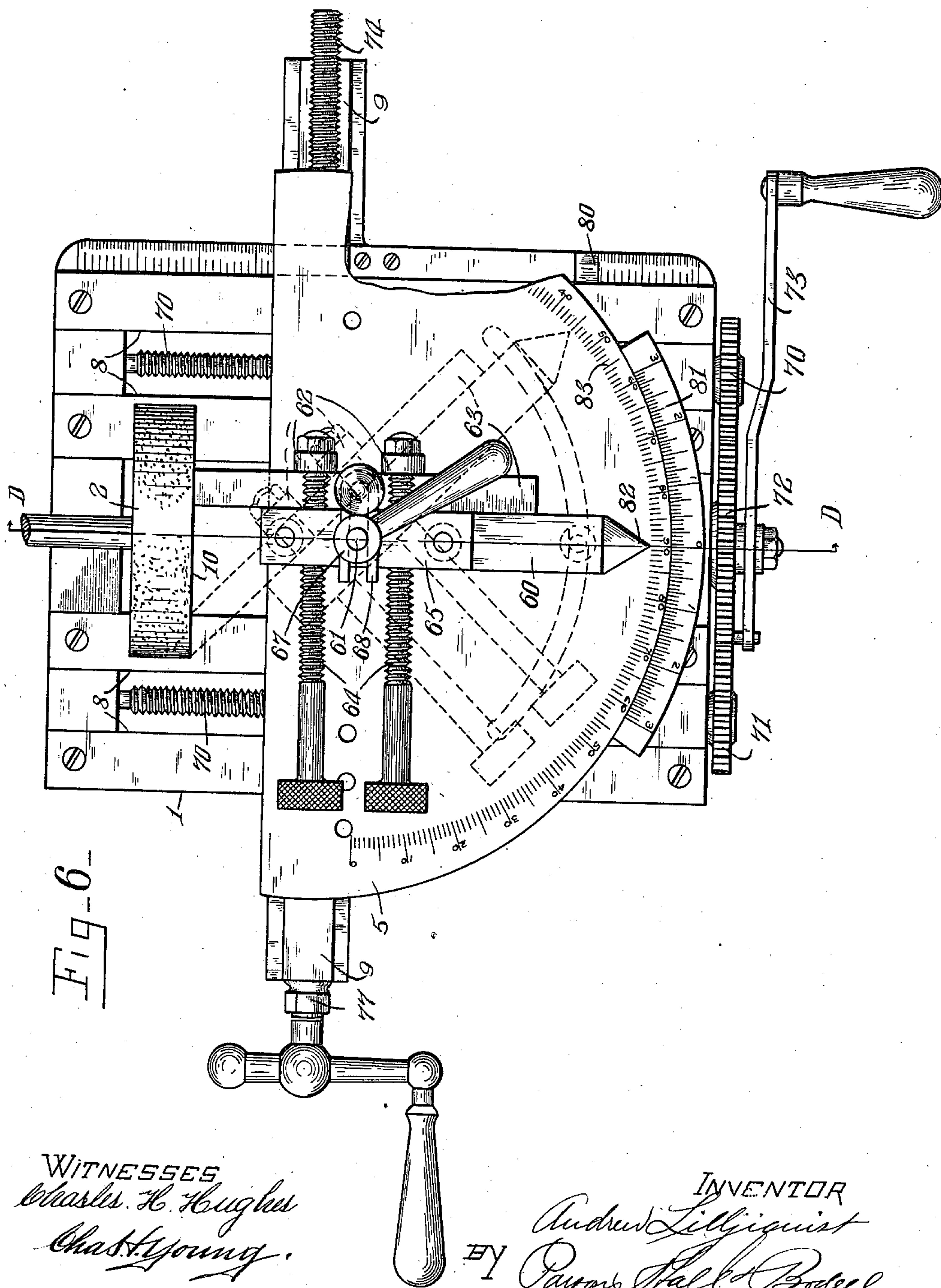


Fig. 6-

WITNESSES  
Charles H. Hughes  
Chas. Young.

INVENTOR  
Andrew Lilljquist  
BY Parson Hall & Bodeel  
ATTORNEYS

A. LILLJQUIST.  
GRINDING MACHINE.  
APPLICATION FILED JAN. 7, 1910.

975,966.

Patented Nov. 15, 1910.

6 SHEETS—SHEET 6.

Fig-7-

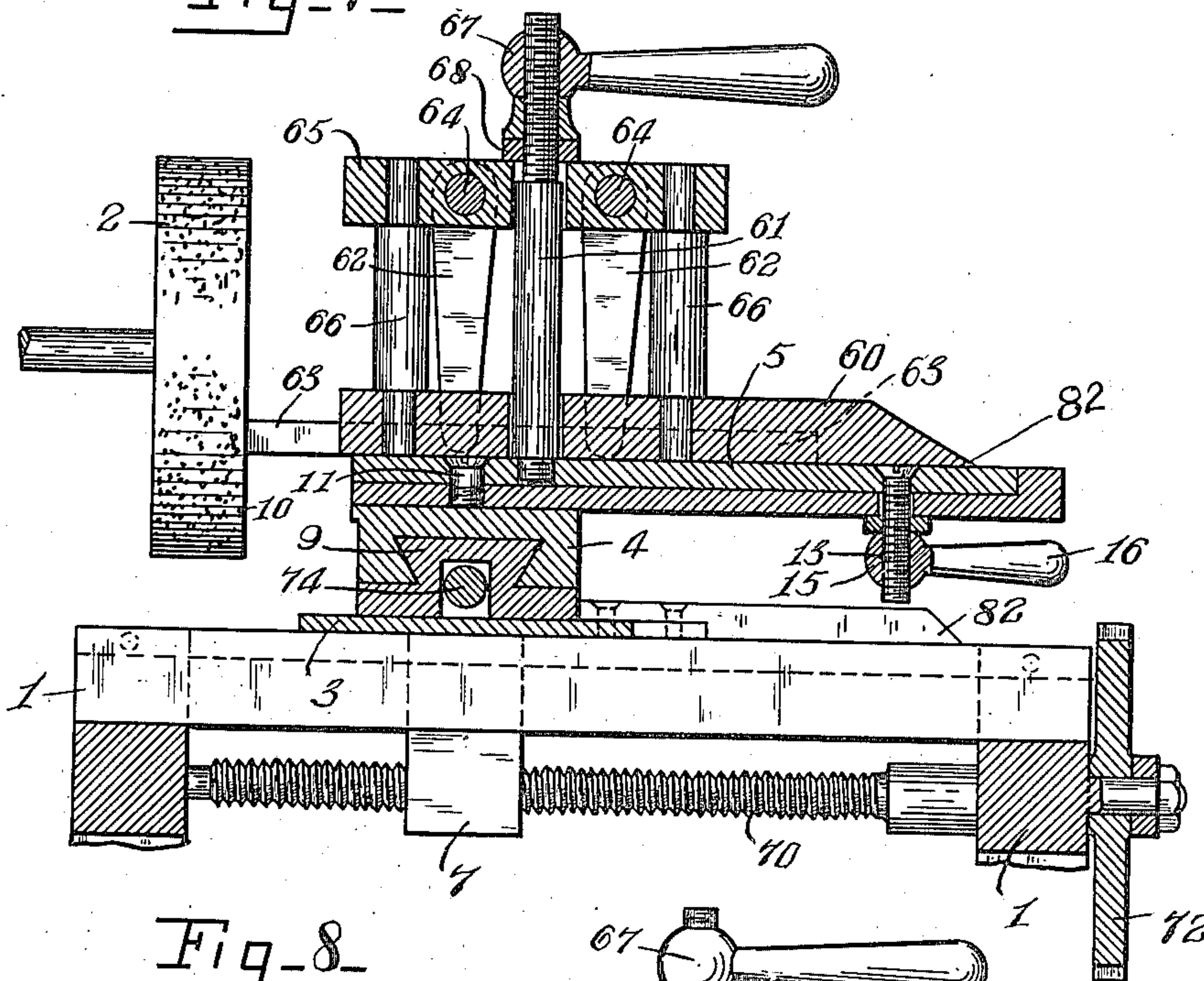
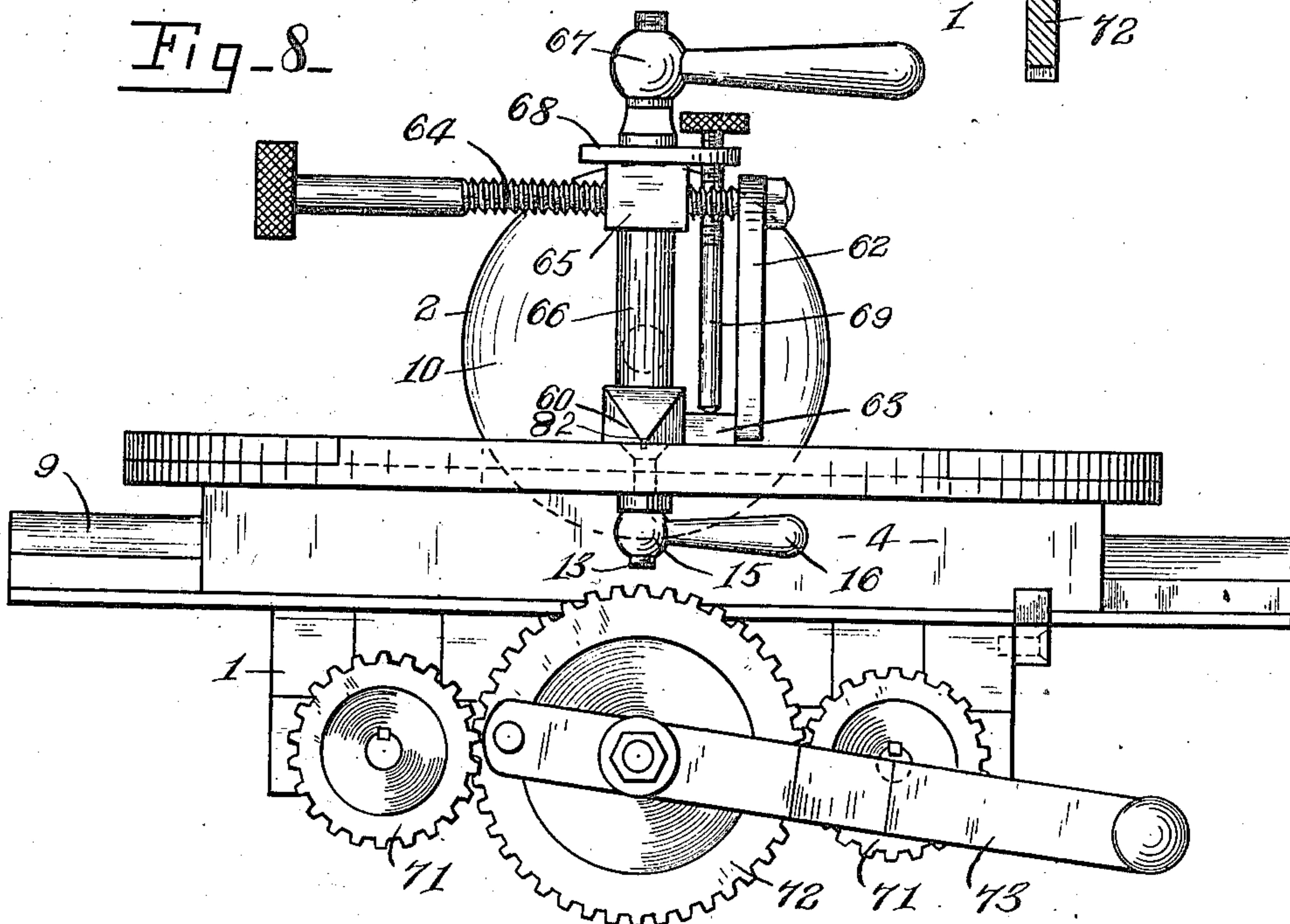


Fig-8-



WITNESSES  
Charles H. Hughes  
Chas. Young.

INVENTOR  
Andrew Lilljquist  
BY Parsons, Hall & Bodell  
ATTORNEYS



# UNITED STATES PATENT OFFICE.

ANDREW LILLJIQUIST, OF SYRACUSE, NEW YORK.

## GRINDING-MACHINE.

975,966.

Specification of Letters Patent.

Patented Nov. 15, 1910.

Application filed January 7, 1910. Serial No. 536,786.

*To all whom it may concern:*

Be it known that I, ANDREW LILLJIQUIST, of Syracuse, in the county of Onondaga and State of New York, have invented a certain new and useful Grinding-Machine, of which the following is a specification.

My invention relates to grinding machines and particularly means whereby elongated articles may be tapered a predetermined amount, and provided with a predetermined number of faces of equal area; and it consists in the combinations and constructions hereinafter set forth and claimed.

In describing this invention reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a plan of my grinding machine illustrating the same as holding an article, rectangular in cross section, to the grinder in position to grind one of the lengthwise faces of said article. Fig. 2 is a plan similar to Fig. 1, showing the machine as holding an article octagonal in cross section, in position to grind one of the faces thereof. Fig. 3 is a section on line A—A, Fig. 1. Fig. 4 is a section on line B—B, Fig. 2. Fig. 5 is a section on line C—C, Fig. 1. Fig. 6 is a plan, partly broken away, of my machine adjusted for grinding an end face of a predetermined bevel. Fig. 7 is a section on line D—D, Fig. 6. Fig. 8 is an end elevation of the machine, it being shown as adjusted in Fig. 7. Fig. 9 is a section on line E—E, Fig. 1. Fig. 10 is a section on line F—F, Fig. 2.

The machine comprises generally a grinding element, a work supporting element provided with work holding means for presenting faces of the work to the grinding element, the work holding means including devices by which the work can be adjusted a predetermined amount after the grinding of each face, so that the finished article will have a predetermined number of faces, means for feeding one of said elements toward the other, and means for determining the amount of feed so that the faces ground thereon will be of equal area.

As here shown this grinding machine comprises a bed 1, a grinding element 2 rotatable about an axis, a carriage 3 movable crosswise of the bed, a carriage 4 mounted on the carriage 3 and movable lengthwise of the bed 1, an adjustable work support or table 5 mounted on and movable with the

carriage 4, and means for feeding the carriages. The bed 1 may be of any desirable form, size and construction. The grinding element 2 may be of any desirable form, size and construction and is here shown as a rotating wheel, usually an emery wheel, supported and actuated in any suitable manner.

The carriage 3 is movable crosswise of the bed 1, and is here shown as provided with projections 7 extending downwardly through parallel guides 8 in the bed for coacting with the feeding means to be described. The carriage 3 is also formed with a guide 9 on its upper face extending crosswise of and at a right angle to the guides 8 and parallel to the side or working face 10 of the emery wheel or grinder. The carriage 4 is movable along the guide 9 by feeding means to be described.

The table 5 is mounted on the carriage 4 and adjustable about the axis of a pivot 11 relatively to the carriage 3 and the grinder 2 for arranging the work 12 with its axis out of parallelism with the working face 10 of the grinder 2, and said table is provided with clamping devices mounted thereon for holding the work. The pivot 11 of the table 5 is preferably arranged parallel to the working face 10 of the grinder and intersects at a right angle the axis of the grinder. Said table is held in its adjusted position by means of a clamping screw 13 threading into the table 5 and extending through an arc-shaped slot 14 in the carriage 4, the screw having a nut 15 provided with a handle 16 located below the carriage 4.

This machine is provided with means for holding the work with its sides to the grinder and also with means interchangeable with the former means for holding the end of the work to the grinder. The means for holding the articles sidewise to the grinder comprises a clamping screw 17 for engaging one end of the work or articles and a device 18 for engaging the other end of said article whereby after one face has been ground on the article it can be turned a predetermined amount so as to present an unground surface to the grinder. The screw 17 and device 18 are carried by adjustable blocks 19, 20 spaced apart on the table 5 in front and in rear of the grinder 2 and clamped to said table by suitable means as screws 21, 22 which extend through lengthwise slots 23, 24 formed respectively in said blocks 19, 20 and into the plate 5.



These slots permit the blocks 19, 20 to be adjusted lengthwise in order to carry the parts 17, 18 toward and from the plane of the working face 10 of the grinder in order to accommodate work of various sizes or diameters. Set screws 25, carried by posts 26 cooperate with the screws 21, 22 to hold the blocks in their adjusted position. The block 20 carries an additional device 27 at its end opposite to the end carrying the device 18, and said block 20 is movable about the pivot or axis of its clamping screw 22 for bringing either one or the other of the devices 18 and 27 into operative position. The device 18 is used when the work is of such length that it can be arranged at a right angle to the block 20 Fig. 1, and the device 26 is used when the work is too long or too short to be arranged with its axis at a right angle to the block 20, Fig. 2. The holding device 18 consists of a member as a collar 28 adapted to be mounted on and fixed to the work 12, said collar having a hub 29, Fig. 9, projecting into the block 20 and cooperating with the clamping means which normally prevents the collar and the work from turning relatively to the block 20.

The collar 28 is provided with peripheral indicating numerals which when brought opposite to similar numerals on the periphery of a member or collar 30 fixed to the block 19, determines the amount of rotation to be given the work after the grinding of each face in order to provide the work with a predetermined number of faces. For example if the numeral 4 is brought successively opposite the numeral 6 on the fixed collar 30, the work will be provided with six faces. If the numerals 6 of the collar 28 are brought successively opposite to the same numeral 6 on the fixed collar 30, the article will be provided with twelve faces. If the numerals 4 on the movable collar 28 are brought successively opposite to the same numeral 4 on the fixed collar 30, the article will be provided with eight faces; and if every other numeral 4 of the collar 28 is brought opposite the same numeral 4 on the fixed collar 30 the article will be ground rectangular.

The means which normally locks the members 28 and 30 from movement relatively to each other comprises two jaws 31, 32, Fig. 9, having arc-shaped faces for engaging the hub 29 of the collar 28, one jaw as 31 having a threaded shank 33 on which turns a nut 34, against a loose collar 35 interposed between said nut and the jaw 31. The nut 34 is provided with a handle 36.

The additional holding device 27, Fig. 10, comprises two members and means for locking the members together, one member 37 projecting from the block 20 and having flat inclined faces 38 and a notch 39 near the apex of said faces, and the other member

consisting of a collar 40 for receiving one end of the work, said collar being provided with an annular series of notches 41 movable into register with the notch 39 and with indicating numerals opposite to the notches 41. Said locking means is a spring-pressed pin or key 42 held by an arm 43 fixed to the block 20 and movable partly into the notch 39 of the member 37 and partly into one of the notches 41 of the member 40.

When it is desired to present a new surface to the grinder the pin 42 is withdrawn against its spring 44 by grasping the handle 45 on said pin, thereby permitting the collar 40 to be turned to adjust the work and to bring another notch 41 opposite to the single notch 39. The work is held between its ends firmly to the grinder by an element 46 swiveled or pivoted between its ends at 47 to the table and having means at one end for engaging the work when it is rectangular as shown in Figs. 1 and 3, and means at its other end for engaging the work when one face of an article to be provided with more than four faces has been ground thereon, Figs. 3 and 4. The first-mentioned means comprises a block 48 movable along an upright guide 49 extending parallel to the working face 10 of the grinder, said block having a face 50 for engaging one of two faces of the work arranged at a right angle to each other and said block having a screw 57 for clamping a part 53 which engages the other of said two faces of the article or work being ground rectangular. The block 48 is held in its adjusted position by a clamping screw 54 extending through the guide 49 into the block 48 and having a head turning thereon against the outer face of the guide.

The means for engaging one of the faces of the work to be provided with more than four faces comprises a disk 55 having a flattened peripheral face 56 for engaging the ground faces of the work, said disk being adjustable about its axis to accommodate any angle of incline of the faces and being held in its adjusted position by a clamping screw 57. The element 46 is adjustable about its pivot 47 to bring one or the other of the holding means at its ends into operative position, and it is held in its adjusted position by a nut 58 turning the threaded end 59 of the swivel pin.

For holding articles on the ends of which bevel faces are to be ground, the machine is provided with an element 60, Figs. 6, 7 and 8, interchangeable with the element 46, said element 60 being adapted to be mounted on the swivel pin 61 turning in the table and interchangeable with the pivot 47, and said element 60 consists of two clamps 62 adapted to engage the work 63, these clamps including arms depending from screws 64 extending transversely through a support 65 lo-



cated above the element 60 and supported on said element by posts 66. A nut 67 turns on the end of the swivel pin 61 and against a supporting arm 68 which carries an upright screw 69 for engaging the top face of the work 3. The arrangement of the support 65 clamps 62 and screw 64 permits articles of different sizes to be held by the element 60.

10 The carriage 3 is fed crosswise in any suitable manner as by means of screws 70 passing through threaded passages in the projections 7 of the carriage, each screw being fixed at one end in the bed 1, and  
15 having a pinion 71 at its other end which meshes with the driving gear 72 provided with a crank handle 73, the driving gear being located between the pinion 71. The carriage 4 may be fed lengthwise by a lead  
20 screw 74 extending in a threaded passage in the projection 75 of the carriage and through a bearing 76. The lead screw 74 is detachably held in the bearing by an externally-threaded sleeve 77 turning into the  
25 threaded portion of the bearing and the screw 74 may be removed by detaching the sleeve in order to permit the carriage 4 to be fed by power means as the crank disk 78 and link 79 connected to the carriage 3. The  
30 crank disk 78 may be actuated in any suitable manner.

The amount of feed of the carriage toward the grinder is determined by a scale or gage fixed to the frame 1 and over which moves  
35 an indicator 80 movable with the carriage 4. By means of this scale or gage the operator can determine the amount or width which each face is to be ground. The amount of adjustment of the table 5 about its axis is  
40 determined by a scale 81 on the carriage 3 and progressing in opposite directions from the center point of the scale. By adjusting the table along the scale to a predetermined point the operator can determine how much  
45 taper per lineal unit the article will have; for instance if a given point or indicator, as the point mark 90 on the table 5 is moved to the graduation marked 1 of the scale 81, the operator knows that the article will have  
50 one inch taper to each foot of its length.

For determining the angle or bevel of the end face to be ground on the end of the work, the supporting element 60 is adjusted about its axis or swivel pin 61 so that the  
55 pointer 82 thereon is opposite a predetermined number on a scale 83 designating degrees. For convenience the point 90 of this scale is used as the indicator for the scale 81 to determine the position of the table when the  
60 table is adjusted about its axis.

In operation to provide an article with tapered faces the article is clamped in position in one of the ways described, the table  
5 is adjusted about its axis and the cross  
65 feed carriage 3 fed slowly toward the

grinder to a given point shown by the indicator 80. When the face has been ground the adjustable holding device 18 or 27 for the work is operated in order to present a new face of the work to the grinder, and the  
70 cross feed carriage is again fed toward the grinder a predetermined amount so that the article when finished is tapered and provided with a predetermined number of faces of equal area.

75 When it is desired to use the machine for grinding a bevel end face on work, the holding element 60 is interchanged for the other element 46, the work clamped therein and said element is adjusted along the scale 83  
80 to the predetermined number of degrees and the carriage is fed toward the working face of the grinder.

What I claim is:—

1. In a grinding machine, a movable carriage, a grinding element, a work supporting element provided with means for holding the work to the grinding element, one of said elements being mounted on the carriage and movable therewith and one of  
85 said elements being adjustable about an axis relatively to the other for arranging the plane of the working face of the grinding element and the longitudinal axis of the work out of parallelism with each other,  
90 means for feeding the carriage, and means for determining the amount of feed of the carriage so that a face of predetermined area is ground on the work, and said work holding means including a device for  
100 adjusting the work about its longitudinal axis a predetermined amount so that the finished article is tapered and provided with a predetermined number of faces of equal area, substantially as and for the purpose de-  
105 scribed.

2. In a grinding machine, a grinding element, a bed, a carriage supported by and movable relatively to the bed toward and  
110 from the grinding element, a work supporting element mounted on and movable with the carriage and including a table adjustable about an axis relatively to the carriage and work holding means mounted  
115 on the table, means for feeding the carriage, means for determining the amount of feed of the carriage toward the grinding element so that a face of predetermined area will be ground on the work, and means for determining the amount of movement of the  
120 table about its axis in order that the face ground on the work extends at a predetermined incline relatively to the axis of the work, the work holding means including a device adjustable for turning the work about  
125 its axis, a predetermined amount, so that the finished article is tapered and provided with the predetermined number of faces of equal area, substantially as and for the purpose  
130 set forth.



3. A grinding machine comprising a rotatable grinder, a bed, a carriage movable lengthwise of the bed parallel to the working face of the grinder and crosswise of the bed toward and from the grinder, a work supporting table mounted on the carriage and adjustable about an axis arranged parallel to the plane of the working face of the grinder and intersecting at a right angle the axis of the grinder, work holding means mounted on the table, means for feeding the table crosswise of the bed toward and from the grinder, means for determining the amount of crosswise feed of the carriage so that the work is provided with a face of predetermined area, means for determining the amount of movement of the table about its axis, so that the face ground on the work extends at a predetermined incline to the axis of the work, and means for feeding the carriage lengthwise of the bed, substantially as and for the purpose described.

4. A grinding machine comprising a rotatable grinder, a bed and a carriage movable lengthwise of the bed parallel to the working face of the grinder and crosswise of the bed toward and from the grinder, a work supporting table mounted on the carriage and adjustable about an axis arranged parallel to the plane of the working face of the grinder and intersecting at a right angle the axis of said grinder, work holding means on the table, means for feeding the table crosswise of the bed toward and from the grinder, a gage for determining the amount of crosswise feed of the carriage so that the work is provided with a face of predetermined area, a scale carried by the carriage and fixed relatively to the table for determining the amount of movement of the table about its axis so that the face ground on the work extends at a predetermined incline to the axis of the work, means for feeding the carriage lengthwise of the bed, said work holding means including a device for adjusting the work about its axis a predetermined amount whereby the finished article is tapered and provided with a predetermined number of faces of equal area, substantially as and for the purpose specified.

5. In a grinding machine, a grinder, a carriage movable toward and from the grinder, and a work supporting table mounted on and movable with the carriage, the table being provided with means for holding the work, said means including clamping devices spaced apart and adjustable relatively to the table toward and from the plane of the working face of the grinder, substantially as and for the purpose set forth.

6. In a grinding machine, a grinder, a carriage movable toward and from the grinder and a work supporting table mounted on and movable with the carriage and

provided with means for holding the work, the work holding means including blocks spaced apart and located in front and in rear of the grinder, the blocks being provided with lengthwise slots, clamping means extending through the slots and into the table and clamping devices for engaging the work, said devices being carried at the ends of the blocks, substantially as and for the purpose described.

7. In a grinding machine, a grinder, and a work supporting table provided with means for holding the work to the grinder, the work holding means including elements arranged in front of the plane of the working face of the grinder, one of said elements including a block pivoted to the table and having devices at opposite sides of its pivot for engaging and holding the work, the block being movable about its axis for bringing one or the other of said members at its ends into operative position, substantially as and for the purpose specified.

8. In a grinding machine, a grinder, and a work supporting table provided with means for holding the work to the grinder, said means including blocks arranged in front of the plane of the working face of the grinder, each block being formed of a lengthwise slot, clamping means extending through the slot and into the table, a spindle carried by one of the blocks for engaging one end of the work and permitting rotation of the work, and the other block being provided with devices at opposite sides of its clamping means for engaging and holding the opposite end of the work, the latter means being operable for rotating the work predetermined amounts, the last-mentioned block being movable about its axis for bringing one or the other of said devices into operative position, substantially as and for the purpose set forth.

9. In a grinding machine, a grinder, and a supporting table provided with means for holding the work to the grinder, the work holding means including a clamping device for holding one end of the work and permitting adjustment of the work about its axis, said devices including a block mounted on the table, two members, one being carried by the clamping block and the other consisting of a collar adapted to be fixed to the work, the collar being connected to the first-named member and provided with a series of indicating characters and being adjustable relatively to said one member for turning the work about its axis, and means for normally locking said members together, substantially as and for the purpose described.

10. In a grinding machine, a grinder, and a work supporting table provided with



means for holding the work to the grinder, the work holding means including a clamping device for holding one end of the work and permitting adjustment of the work about its axis, said device including a block mounted on the table, two members, one being carried by the block and being provided with a notch and the other member consisting of a collar adapted to be fixed to the work, the collar being connected to the first-named member provided with an annular series of notches and indicating characters associated with the notches, said notches being adapted to be brought into registration successively with the first-mentioned notch as the collar is turned to adjust the work and a key movable into and out of the notches in registration, substantially as and for the purpose specified.

11. In a grinding machine, a grinder, and a work supporting table provided with means for holding work to the grinder, the work holding means including a block pivoted between its ends to the table and having means on opposite sides of its pivot for engaging one end of the work and permitting adjustment of the work about its axis, said block being movable about its axis for bringing either of the engaging means into operative position, each engaging means including two members, one being carried by the block and the other member consisting of a collar adapted to be fixed to one end of the work, the collar being connected to the member fixed to the block and provided with an annular series of indicators for determining the amount of adjusting movement to be given the work, and means for normally locking the members together, substantially as and for the purpose set forth.

12. In a grinding machine, a grinder, and a work supporting table provided with means for holding the work to the grinder, the work holding means including an element pivoted to the table between its ends and having a part at one end thereof for engaging faces of the work arranged at a right angle to each other and a part at the other end of the work for engaging one of the faces of an article being provided with

more than four faces, the said member being movable about its axis for bringing either of said parts into operative position, substantially as and for the purpose described.

13. In a grinding machine, a grinder, and a work supporting table provided with means for holding the work to the grinder, the work holding means including an element pivoted to the table between its ends and having a part at one end thereof for engaging faces of the work arranged at a right angle to each other and a part at the other end of said means for engaging one of the faces of an article being provided with more than four faces, the latter means including a disk adjustable about an axis and having a flattened peripheral portion for engaging an inclined face of the work and said element being movable about an axis for bringing either one or the other of said parts into operative position, substantially as and for the purpose described.

14. In a grinding machine, a grinder, a carriage movable toward and from the grinder, a work supporting table mounted on the carriage and adjustable about an axis relatively thereto, work holding means mounted on the table and including devices for holding the work with its lengthwise sides to the grinder, said devices being operable for adjusting the work about its axis and presenting a predetermined number of faces consecutively to the grinder, means for feeding the carriage, a gage for determining the amount of feed of the carriage toward the grinder, and a scale for determining the amount of movement on the table about its axis in order to determine the amount of taper of the article, substantially as and for the purpose specified.

In testimony whereof, I have hereunto signed my name in the presence of two attesting witnesses, at Syracuse, in the county of Onondaga, in the State of New York, this 14th day of June, 1909.

ANDREW LILLJQUIST.

Witnesses:

S. DAVIS,  
E. R. SEEMILLER.