A. M. SOSA.

DRIVING AND FEEDING MECHANISM IN METAL WORKING MACHINERY.

APPLICATION FILED SEPT. 6, 1910.

1,074,906.

Patented Oct. 7, 1913.

2 SHEETS—SHEET 1.

Fig. 1

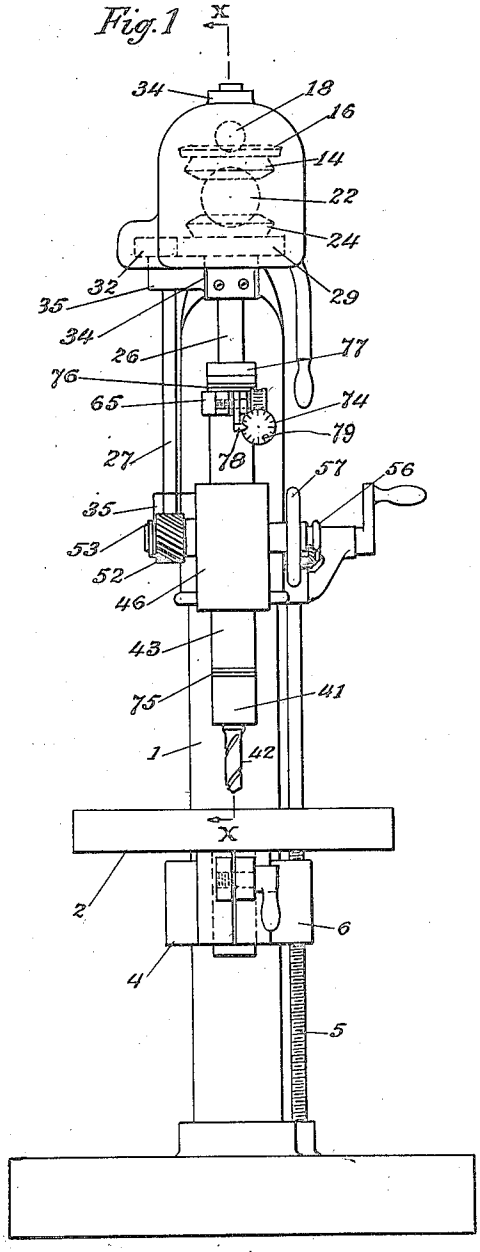
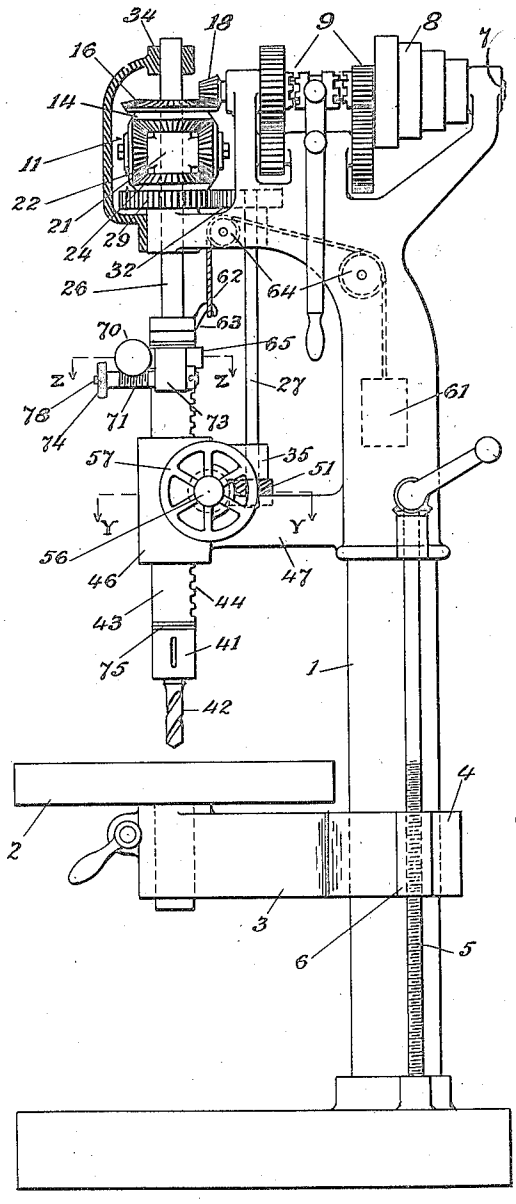


Fig. 2.



Witnesses.

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2 SHEETS—SHEET 2.

Fig. 3

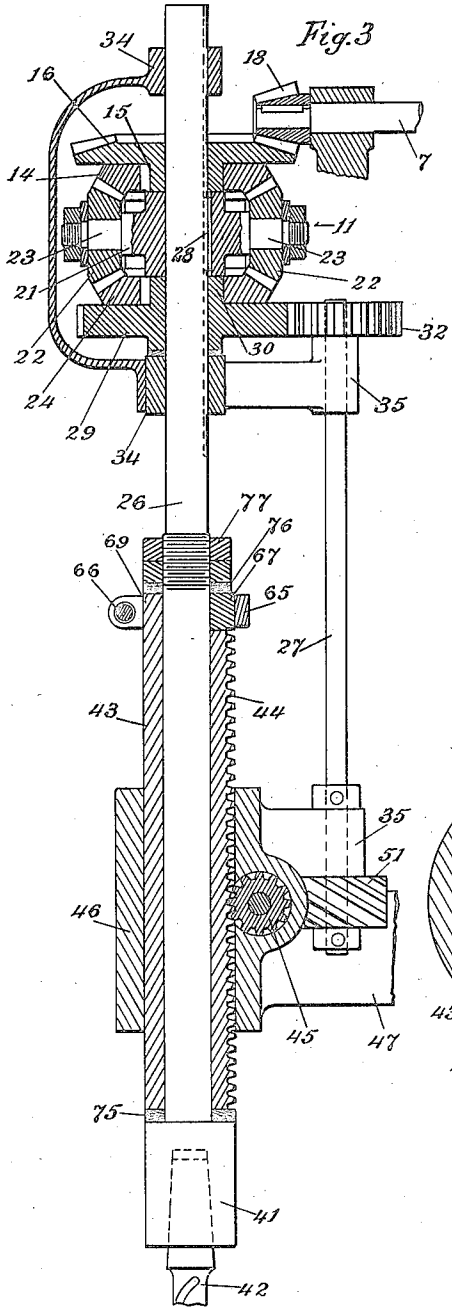


Fig. 5

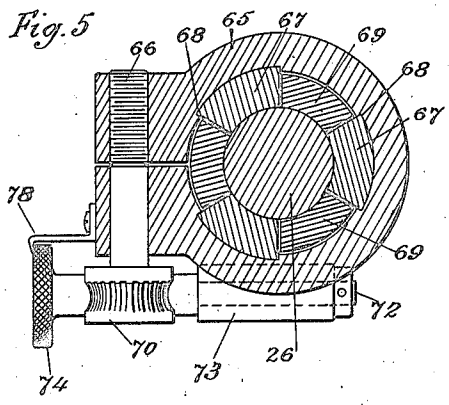
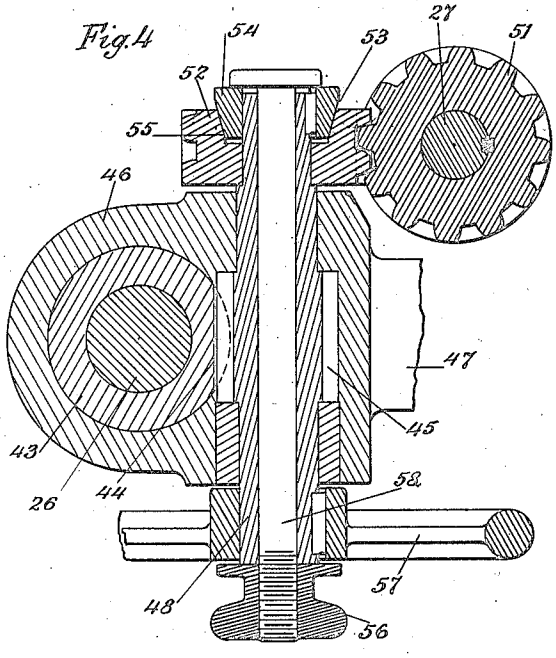


Fig. 4



Witnesses.

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UNITED STATES PATENT OFFICE.

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DRIVING AND FEEDING MECHANISM IN METAL-WORKING MACHINERY.

1,074,906. Specification of Letters Patent. Patented Oct. 7, 1913.

Application filed September 6, 1910. Serial No. 580,692.

To all whom it may concern:

Be it known that I, AUGUSTUS M. SOSA, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Driving and Feeding Mechanism in Metal-Working Machinery, of which the following is a specification.

My invention relates to driving and feeding mechanism in metal working machinery for accomplishing the rotating and linear movements which take place between the tool and the work.

My invention is applicable in metal working machines in which the feeding or linear movement is substantially continuous during the cutting operation, as for instance in drilling machines, in which the tool is caused to rotate with relation to the work and is also caused to be fed toward the work in performing the cutting; in milling machines, in which the tool is caused to rotate and the work is fed past the tool while cutting; in turning machines, in which the work is caused to rotate and the tool while cutting is fed across the work; and in other metal working machinery in which there are corresponding rotating and linear movements between the tool and work in accomplishing the cutting function.

The two forces for accomplishing respectively the cutting movement and the feeding movement have, in machines of the character mentioned, heretofore been usually transmitted, where accomplished by power, through two separate trains of gearing, either positive or frictional, independently controlled. These means have usually in practice been designated as a speed changer or speed-box when interposed in the train of gearing of the cutting or driving force, and by the term feed-changer or feed-box when interposed in the train of gearing of the feeding force.

It is the object of my invention to provide driving and feeding mechanism in metal working machinery for accomplishing the rotating and feeding movements between the tool and work by means which react one upon the other, further to provide cutting and feeding means correlated so as to act in antagonism to each other for maintaining the effectiveness of their movements; further to provide adjusting means whereby the cutting and feeding movements may be relatively affected; further to provide means whereby the relation between the rate of feed and the speed of rotation in performing the cutting operation may be changed during maintenance of the gear connections which accomplish said feed and rotation but under elimination of the aforesaid feed changers or feed boxes; further to provide means in which the driving and feeding movements automatically act one against the other; further to provide means whereby the different resistances between the tool and work present in the cutting movements when employing tools of different sizes are respectively automatically caused to act upon the feeding force for determining the amounts of feed between the tool and work when employing any given size of tool; and further to provide means whereby tools of greater cutting resistance transfer greater feeding force than tools of smaller cutting resistance.

I have exemplified my invention as applied in a drilling machine of simple form, from which the principle of its application to other forms of drilling machines and other machines of the character mentioned will be understood.

My invention will be further readily understood from the following description and claims, and from the drawings, in which latter:

Figure 1 is a front elevation of a drilling machine embracing my invention. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical section taken on the line *x*—*x* of Fig. 1. Fig. 4 is a horizontal section taken on the line *y*—*y* of Fig. 2; and Fig. 5 is a detail in horizontal section on the line *z*—*z* of Fig. 2.

1 represents the frame of the machine which may be of any suitable form. 2 is a suitable work-support which, as shown, is arranged to be adjusted toward and from the cutter position, as by being mounted on a bracket 3 having a bearing 4 about the frame or column, a screw-rod 5 being received in a threaded bearing 6 and turned in suitable manner for positioning the bracket. 7 is a drive-shaft, driven in suitable manner, to which various speeds may be imparted by suitable mechanism, shown as a cone pulley 8 and back-gearing 9. The parts just described may be of any usual or ordinary form of construction.

11 represents an epicyclic train of gearing, and may be any suitable form of gear-train of that character, the bevel-gear type of epicyclic gear-train being shown, and preferably embraces a driving member and two driven members, one of which driven members is primarily instrumental in accomplishing the cutting operation between the tool and the work and the other of which driven members is primarily instrumental in accomplishing the feeding movement between the tool and work, the resistances of said operations in said respective driven elements reacting upon one another for inducing relative effectiveness in said respective operations. Thus 14 is the driving member of my improved train of gearing and in the form shown is arranged to be driven by being rigidly connected with the hub 15 of a bevel-gear 16, the bevel-gear 16 receiving its motion from a bevel-pinion 18 on the drive-shaft 7.

21 is a rotatable frame on which bevel-pinions 22 rotate on studs 23.

24 is a bevel-gear which is a mate to the bevel-gear 14, the bevel-pinions 22 being arranged to rotate between said bevel-gears 14 and 24. The bevel pinions 22 form planetary gears.

26 is the spindle and may represent the driving means for causing cutting movement between the tool and work, and 27 is the feed-shaft of the machine, the first of these shafts being arranged to accomplish relative rotation between the tool and the work and the second of these shafts being arranged to accomplish relative linear movement between the tool and the work, the first of these movements being instanced in the present exemplification as a rotating tool movement and the second as a longitudinal tool movement.

One of the driven members, instanced as the rotatable frame 21, is shown as having driving connection with the arbor or shaft 26 and the other of said driven members, namely the bevel-gear 24, is shown as having driving connection with the feed-shaft 27. The driving connection between the rotatable frame and the drill spindle is accomplished by the spline-connection 28. The driving connection between the bevel-gear 24 and the feed-shaft is accomplished by the spur-gear 29, upon the hub 30 of which the bevel-gear 24 is rigidly secured, the spur-gear 29 meshing with a gear 32 secured to the feed-shaft 27.

The spindle 26 is journaled and has longitudinal movement in bearings 34 on the main frame, and the feed-shaft 27 is journaled in bearings 35 of the main frame. The spindle has thereon a suitable tool-holder, shown at 41, arranged to receive the tool, shown as a drill 42. 43 is a sleeve in which the spindle rotates and which is provided with a rack 44 with which a feed-pinion 45 meshes, and may represent the feeding means for causing feeding movement between the tool and work. The sleeve has longitudinal movement but is prevented from turning in a bearing 46 on a bracket 47 extending from the main frame. The pinion 45 is on a shaft 48 and is operated from the feed-shaft, as through the medium of a spiral gear 51 on the feed-shaft which meshes with a spiral gear 52 received about the shaft 48. A hand-wheel 57 is provided, by means of which the feeding of the drill may be controlled by hand either independent of or in conjunction with the power feed.

In my invention one of the driven members has operative connection for causing cutting movement between the tool-holder and work-holder, and the other driven member has operative connection for causing feeding movement between the tool-holder and work-holder, both connections in the present exemplification being made with the tool-holder for causing the tool-holder to both rotate and have linear movement, although it is obvious that it is within the scope of my invention that the connections be so made as to cause different relations of movement between said holders, as stated in the third paragraph of this specification.

Each of the driven members of the epicyclic train of gearing has operative connection with one of said holders, that is to say, one of said driven members has operative connection with one of said holders, and the other of said driven members has operative connection with one of said holders, instanced in the present exemplification as the same holder.

The spindle may be counterweighted as by a weight 61 suspended from a flexible connection 62 secured with relation to the spindle-sleeve as at 63, and received over rollers 64 in the column.

The ratio of the feed gears 29, 32, 51, 52 is made so as to offer a given resistance, as by means of the angle of the spiral gears 51 52, which angle is selected to suit the construction and the performance desired. This angle of resistance is but slight, so that the said train of gears, by reason of this angle, offers but slight resistance to the force applied thereto. Taking this angle of resistance and the fact that the spindle is in the present instance counterweighted into consideration, we will follow the tool in its operation.

Driving power is delivered to the driving member or gear 14. Resistance being offered by the feed gears, by reason of the angle of resistance stated, the pinions 22 will roll around the gear 24, forming planetary gears with relation thereto, and carrying the rotatable frame 21 and the spindle

26 with them in their movement at a speed of one-half that of gear 14. This movement will continue as long as no resistance is offered to the rotation of the spindle. I prefer however to provide such spindle resisting means and have done so in the present instance in the form of a split-ring 65 controlled by a screw 66, the split-ring having friction-shoes 67 received in recesses 68 therein, the shoes being received between fingers 69 at the end of the sleeve 43.

I provide delicate control for the spindle-resisting means and a minute gage for determining the resistance applied, for instance by providing the screw 66 with a worm-wheel 70 engaged by a worm 71 on a shaft 72 in a bearing 73 on the split-ring, there being a hand-wheel 74 for said shaft having an index 79 thereon, with the marks of which a finger 78 secured to said split-ring, is adapted to register.

The sleeve 43 is longitudinally stationary with relation to the spindle 26 as by having the lower end thereof received against collars 75 limited by the tool-holder 41, and collars 76 between the upper end of the sleeve and nuts 77 threaded to said spindle. If now, resistance is offered to the turning of the spindle, as by turning the shaft 72, this resistance counteracts the resistance of the feed-gears mentioned. These resistances are in practice only small in amount. I prefer to offer such resistance, hereinafter referred to as the initial or artificial resistance, to the running of the spindle as to overbalance the resistance of the feed-gears, in order that rotation of the spindle may be checked and motion in the feed train be initiated and normally maintained, the bevel-pinions 22 normally acting as transmitting gears, transmitting motion to the bevel-gear 24 and from this bevel-gear to the spur-gears 29 and 32, feed-shaft 27, the gears 51 52, the feed-pinion 45 and sleeve 43, causing movement of said sleeve and the spindle longitudinally toward the work, being an advance movement of said spindle.

Experiments show that in the operation of metal working machines in which the cutting and feeding movements are caused by relative rotary and linear movements between the tool and work, that the two forces mentioned, turning moments in drive and end thrust in the feed, do not, for reasons applicable in the particular machines, increase proportionally, the forces of the end thrusts of the feed increasing in greater ratio than the forces of the turning moments of the drive. In drilling machines, for instance, as the amount of feed per turn increases, the end thrust required to feed the drill increases in greater ratio.

In my improved device, with a given size of drill and with a given gear-ratio for the feed, a point can be reached therefore at which the feeding force will equal the spindle turning resistance plus the initial or artificial resistance above mentioned.

In my improved device, the initial resistance above mentioned being applied, the spindle 26 advances until the drill strikes the work, thereby offering resistance to the feeding movement, which resistance re-acts upon the spindle, causing rotation or accelerated rotation thereof, dependent on the amount of the initial or artificial resistance applied. This causes cutting or increased cutting, as the case may be, by the tool, and consequent additional resistance to the rotary movement of the same, which automatically re-acts upon the linear or feeding movement of the drill, for accomplishing the feeding and the cutting movements of the tool.

The feeding action is under instant control of the hand-wheel, the manual force required to accelerate or retard the power feed by hand being very slight.

A clutch may be interposed in one of the feeding elements for permitting expenditure or release of motion when permitting the machine to run idle and to prevent an excess of end-thrust at the drill beyond the capacity of the drill being employed to resist breaking. I have shown this clutch as a friction clutch 53 comprising a friction-plug 54 secured to rotate with the shaft 48 and received in a friction-socket 55 of the gear 52, the clutch being brought into engaging relation by a hand-nut 56 on a threaded rod 58, which draws the friction-plug into the friction-socket or permits release between the friction faces therebetween.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members having reacting connection between them for driving the same, operative driving connection between one of said driven members and one of said holders, and operative feeding connection between the other of said driven members and one of said holders.

2. In a driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members having reacting connection between them for driving the same, operative driving connection between one of said driven members and one of said holders, operative feeding connection between the other of said driven mem-

bers and one of said holders, and adjustable controlling means for one of said driven members, substantially for the purpose described.

3. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a tool-holder and a work-holder, a driving element for one of said holders, a feeding element for one of said holders, an epicyclic gear-train comprising a driving member and a pair of driven members, operative connection between said driving element and one of said driven members, and operative connection between said feeding element and one of said driven members.

4. In a driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members having reacting connection between them for driving the same, operative driving connection between one of said driven members and one of said holders, operative feeding connection between the other of said driven members and one of said holders, and a power-relieving device for one of said driven members, substantially for the purpose described.

5. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a tool-holder, a work-holder, means for causing rotary movement between said holders, means for causing linear movement between said holders, a train of mechanism comprising a driving member and a plurality of driven members having reacting effect upon one another, operative connection between one of said driven members and said means for causing rotary movement between said holders, and operative connection between the other of said driven members and said means for causing linear movement between said holders, substantially for the purpose described.

6. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a tool-holder, a work-holder, means for causing rotary movement between said holders, means for causing linear movement between said holders, a train of mechanism comprising a driving member and a plurality of driven members having reacting effect upon one another, operative connection between one of said driven members and said means for causing rotary movement between said holders, operative connection between the other of said driven members and said means for causing linear movement between said holders, and a retarding means having operative connection with one of said driven members, substantially for the purpose described.

7. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of mechanism concerned in cutting movement between the tool and work, mechanism concerned in feeding movement between the tool and work, an epicyclic train of gearing comprising a driving member and driven members driven by said driving member, said driven members having operative connection with said respective named mechanisms.

8. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a rotary driving element, a linearly movable feeding element, an epicyclic train of gearing comprising a driving member and a pair of driven members driven by said driving member, a train of mechanism embracing one of said driven members having connection with said driving element, and a second train of mechanism embracing the other of said driven members having connection with said feeding element, substantially for the purpose described.

9. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a rotary driving element, a linearly movable feeding element, an epicyclic train of gearing comprising a driving member and a pair of driven members driven by said driving member, a train of mechanism comprising one of said driven members having connection with said driving element, a second train of mechanism comprising the other of said driven members having connection with said feeding element, and power-relieving means for a train of said mechanism.

10. In driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of a rotary driving element, a linearly movable feeding element, an epicyclic train of gearing comprising a driving member and a pair of driven members driven by said driving member, a train of mechanism comprising one of said driven members having connection with said driving element, a second train of mechanism comprising the other of said driven members having connection with said feeding element, and resistance-controlling means for a train of said mechanism.

11. In a driving and feeding mechanism in metal working machinery, the combination of a tool-support, a rotating element and a linearly movable element therefor, an epicyclic gear-train comprising a driving member and a pair of driven members driven by said driving member, and a pair of trains of mechanism, one of said trains

of mechanism comprising one of said driven members and said rotating element, and the other of said trains of mechanism comprising the other of said driven members and said linearly movable element.

12. In a driving and feeding mechanism in metal working machinery, the combination of a tool-support, a rotating element and a linearly movable element therefor, an epicyclic gear-train comprising a driving member and a pair of driven members driven by said driving member, and a pair of trains of mechanism, one of said trains of mechanism comprising one of said driven members and said rotating element, retarding means therefor, and the other of said trains of mechanism comprising the other of said driven members and said linearly movable element.

13. In driving and feeding mechanism for metal working machinery, the combination of a work-support, a tool-support, a train of mechanism causing cutting movement between said supports, a train of mechanism causing feeding movement between said supports, an epicyclic train of gearing comprising a driving member and a pair of driven members, one of said driven members embraced as a driving element in said first-named train of mechanism, and the other of said driven members embraced as a driving element in said second-named train of mechanism.

14. In driving and feeding mechanism for metal working machinery, the combination of a work-support, a tool-support, a train of mechanism causing cutting movement between said supports, a train of mechanism causing feeding movement between said supports, an epicyclic train of gearing comprising a driving member and a pair of driven members, one of said driven members embraced as a driving element in said first-named train of mechanism, the other of said driven members embraced as a driving element in said second-named train of mechanism, and resisting means for said first-named train of mechanism normally causing operation of said second-named train of mechanism.

15. In driving and feeding mechanism for metal working machinery, the combination of a tool-holder and a work-holder constituting a pair of holders, means for driving one of said holders means for feeding one of said holders, an epicyclic train of gearing embracing a driving member and a pair of driven members, operative connection between said driving means and one of said driven members, and operative connection between said feeding means and the other of said driven members, substantially for the purpose described.

16. In a driving and feeding mechanism for metal working machinery employing a tool for cutting work, the combination of driving means and feeding means for causing driving and feeding movements between the tool and work, an epicyclic train of gearing embracing a driving member and a pair of driven members, operative connection between one of said driven members and said driving means, and operative connection between the other of said driven members and said feeding means.

17. In driving and feeding mechanism for metal working machinery, the combination with a tool-holding member, of means for driving and means for feeding said member, an epicyclic train of gearing having a rotary arm, connection between one of said means and the rotary arm of said train, and connection between the other of said means and a rotary and non-planetary wheel of said train.

18. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, and a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation.

19. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation, and adjusting means for qualifying the ratio of said forces.

20. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation, and a power-relieving device affecting the feeding movement between said holders.

21. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, and a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation and embracing mechanism having an angle of resistance which establishes a feed gear ratio in said forces.

22. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation and embracing mechanism having an angle of resistance which establishes a feed gear ratio in said forces, and resistance means auxiliary to said feed gear ratio.

23. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, an epicyclic gear-train comprising a driving member and a pair of driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation, said operative connection for one of said driven members embracing a gear-train having an angle of resistance for establishing a feed gear ratio, and resistance means for the other of said driven members amplifying its cutting resistance.

24. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, and a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation and embracing means normally causing a feeding movement.

25. In driving and feeding mechanism for metal working machinery, the combination of a work-holder, a tool-holder, and a train of mechanism comprising a driving member and a plurality of driven members, said driven members having operative connection causing cutting movement and feeding movement between said holders by forces acting against each other during operation and embracing means normally causing a feeding movement, said last-named means embracing an adjusting element for affecting quantity of feeding movement.

In testimony whereof, I have signed my name hereto, in the presence of two subscribing witnesses.

AUGUSTUS M. SOSA.

Witnesses:

EDWARD SOUTHWORTH,

IDA DAVIS.