

March 16, 1948.

E. W. MASON

2,437,829

SCALPING MACHINE CONTROL APPARATUS

Filed July 25, 1944

4 Sheets-Sheet 1

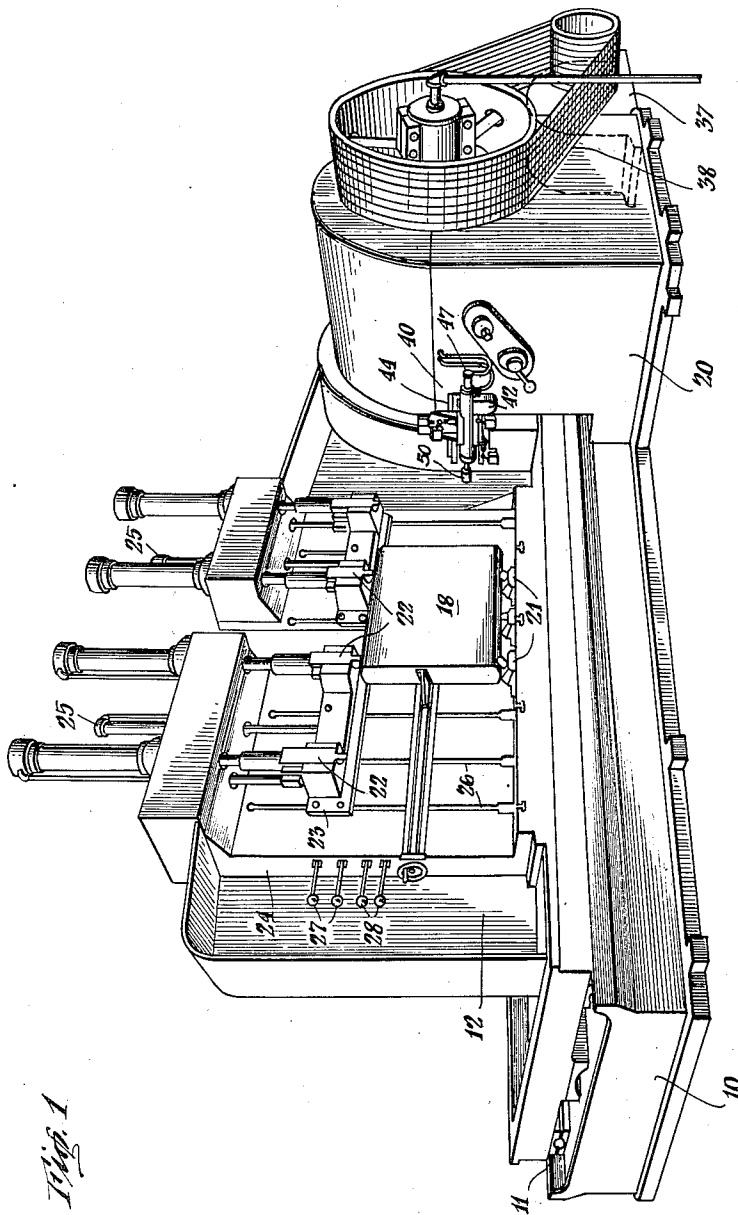


Fig. 1

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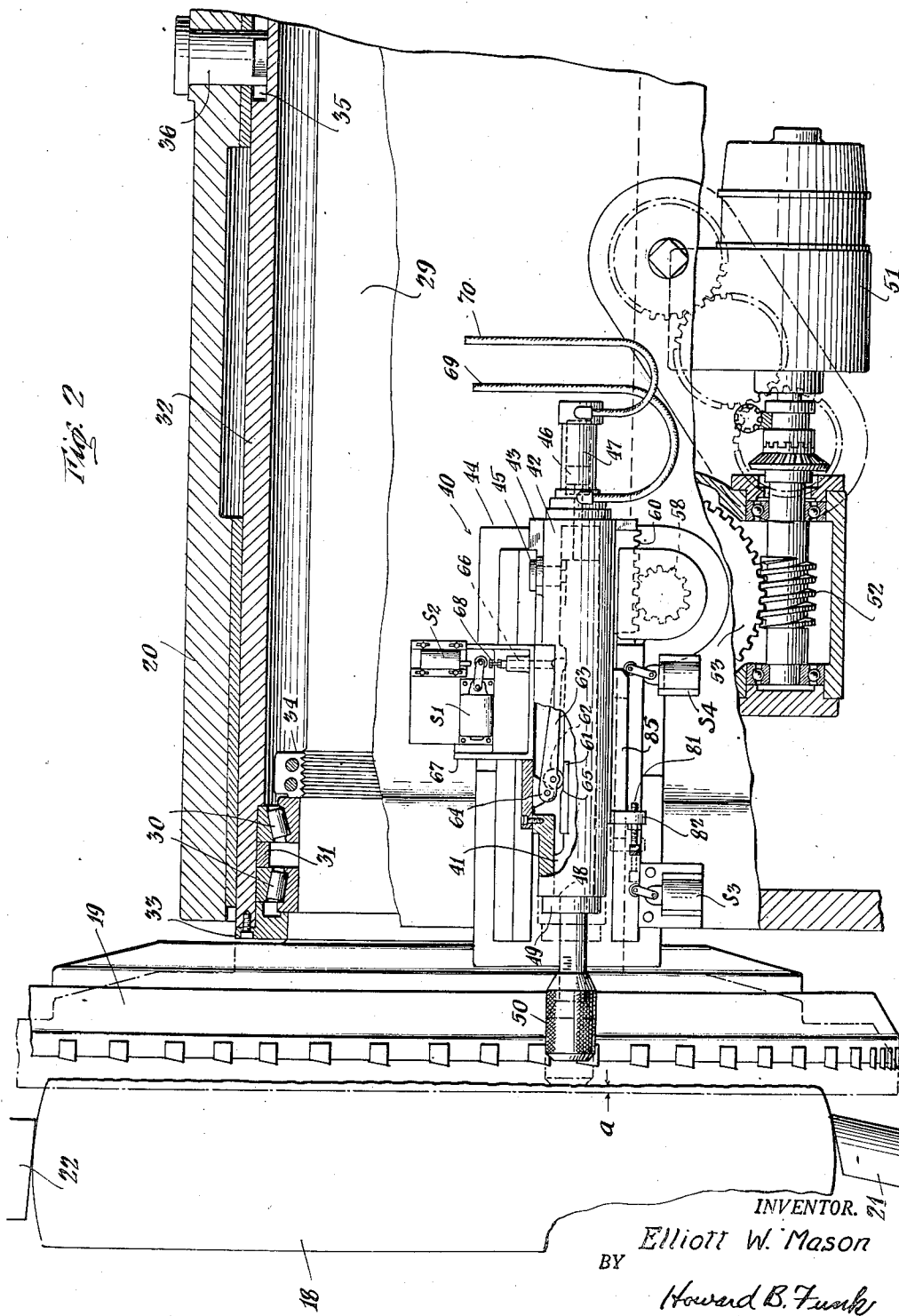
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4 Sheets-Sheet 2



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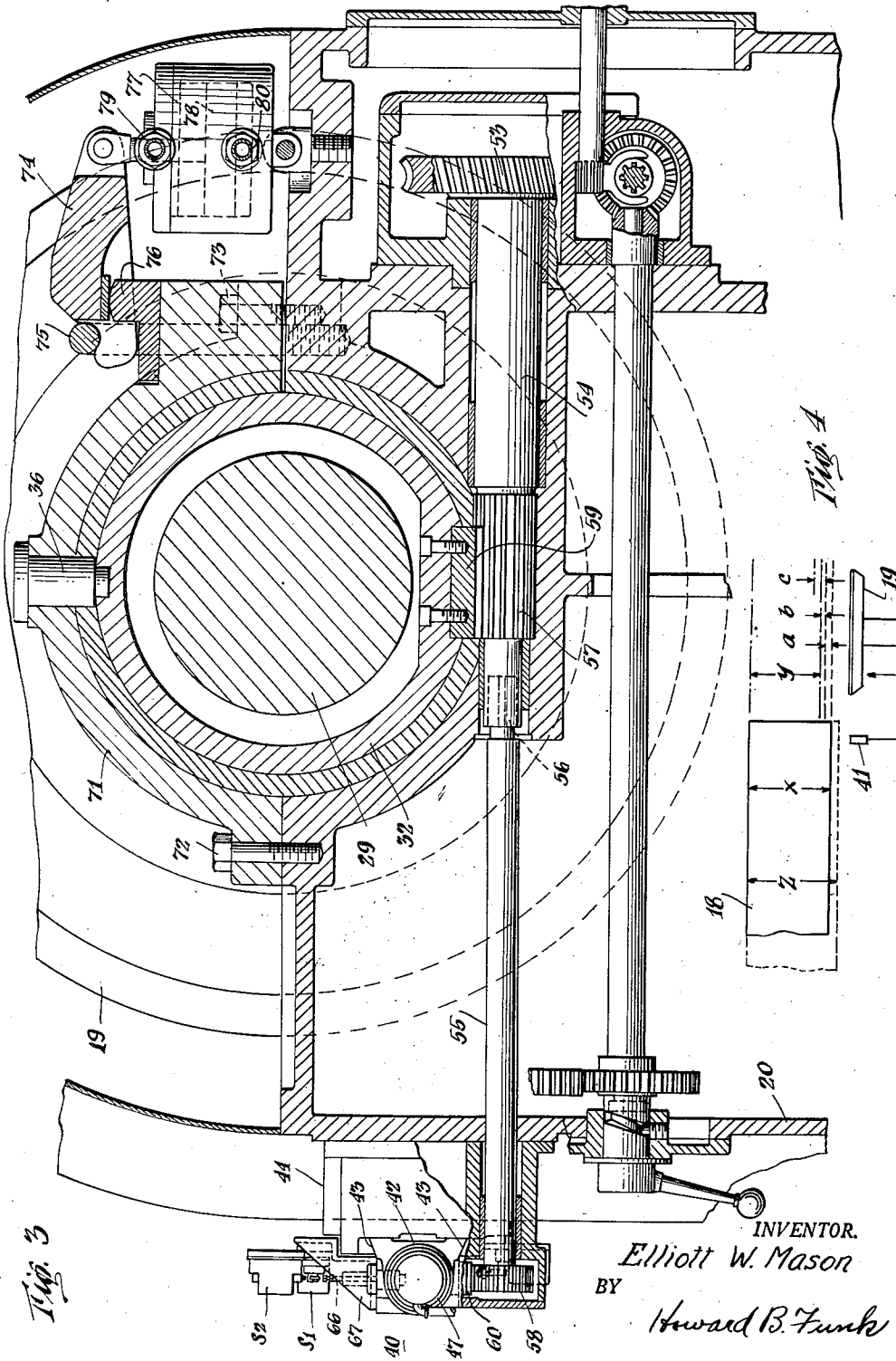


Fig. 3

Fig. 4

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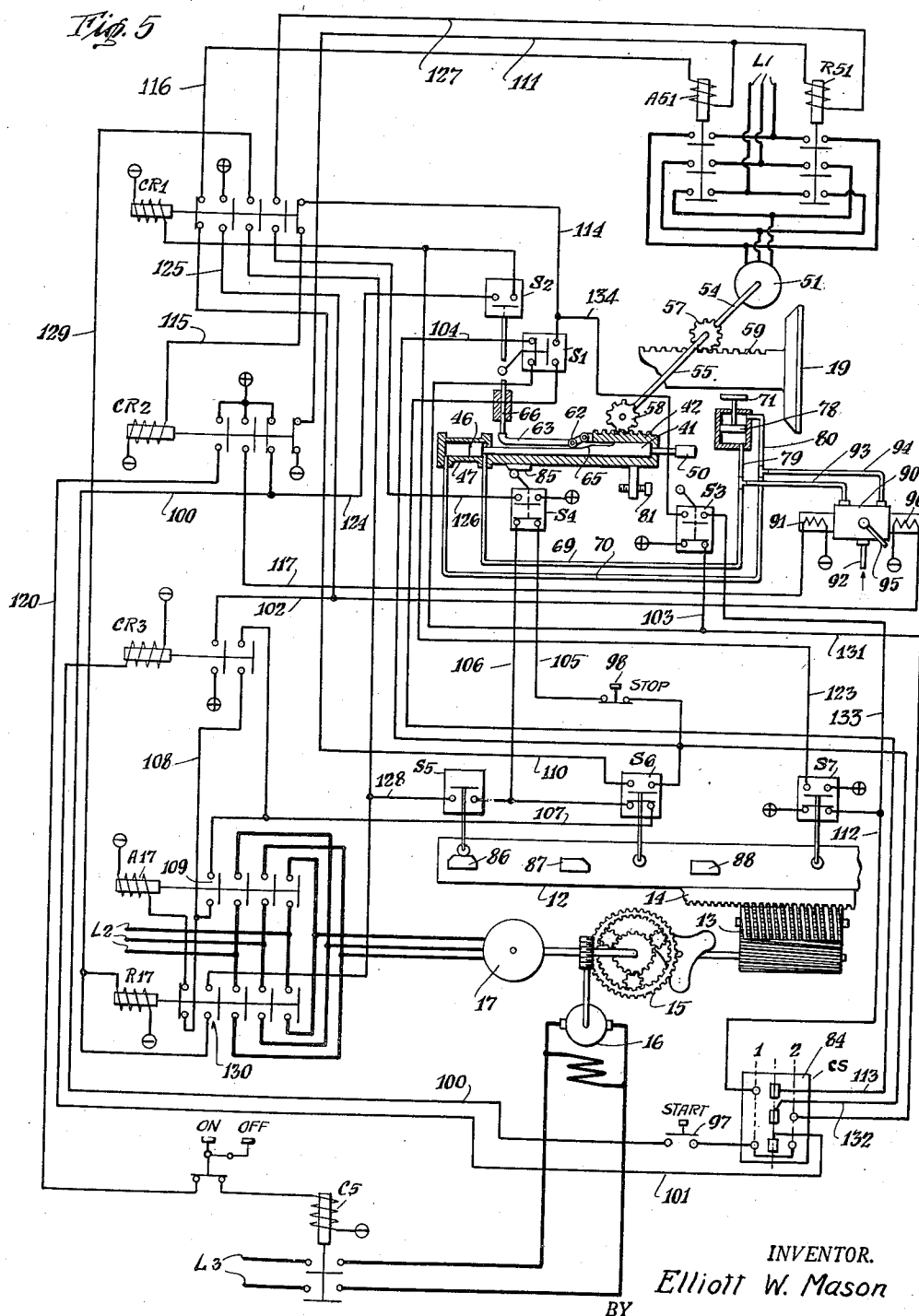
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4 Sheets-Sheet 4



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SCALPING MACHINE CONTROL APPARATUS

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Application July 25, 1944, Serial No. 546,538

9 Claims. (Cl. 90—16)

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This invention relates to machines for scalping ingots and the like, and more particularly to improved cutter control mechanism therefor.

In United States Letters Patent No. 2,142,736, granted January 3, 1939, there is disclosed a scalping machine embodying an axially movable rotary cutter which is automatically adjusted into cutting position preliminary to the cutting operation under control of a gauge or feeler mechanism that cooperates with a presented face of an ingot or slab of metal to be scalped. In the operation of this type of machine, because a layer of metal of the same thickness is removed from the opposite faces of each ingot, the variations in thickness of ingots nominally of the same size are reproduced in the scalped ingots. Such thickness variation is undesirable for subsequent rolling operations as it introduces operational factors into the rolling schedule which the operators must be on the lookout to correct. Especially is this so in case liner metal is placed on the top and bottom scalped faces of sheet ingots and rolled therewith to become bonded to and integral with the base metal core, as typified by the rolling of alclad sheet and plate of aluminum alloy. By supplying ingots in scalped condition for rolling that are all of substantially the same thickness, uniform spreading of the liner metal on the sticker pass can be effected and roll settings of all roll stands can be preset, and a sheet product of more uniform coating and quality produced without delays incident to adjusting the mill.

Accordingly, a particular object of the present invention is to provide a scalping machine of the type hereinabove referred to that is adapted to produce scalped ingots of predetermined thickness as measured between opposite scalped faces thereof.

Another object of the invention is to provide in a machine of the type mentioned, selectively operable control means for so controlling the adjustable cutter automatically as to produce scalped ingots of identical thickness.

A further object of the invention resides in the provision of novel control means for an adjustable cutter effective to protect the cutter against overloading in the event the amount of metal required to be removed thereby from a face of an ingot presented thereto exceeds a preselected thickness.

Still another object is to provide a machine tool of the character referred to in which the machine cycle time to produce scalped ingots of uniform thickness with at least two machined faces is substantially reduced.

In the accompanying drawings illustrating the invention,

Fig. 1 is a perspective view of a particular form of machine tool for scalping ingots and the like;

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Fig. 2 is an enlarged sectional elevational view of a portion of the axially shiftable cutter mechanism of the machine tool, shown prior to its movement into cutting relationship with the work piece;

Fig. 3 is an enlarged transverse sectional view of the tool head shown in Figs. 1 and 2;

Fig. 4 is a diagram illustrating the cutting sequence and operating conditions; and

Fig. 5 is a schematic wiring diagram of the control system.

Referring to Fig. 1, the numeral 10 represents an elongated machine tool bed of any suitable construction that is provided with suitable ways 11 on which is slidably supported a work clamping fixture or carriage 12 for longitudinal traversing movement. Any suitable driving mechanism may be provided to impart forward and backward movement to the clamping fixture, a well known form of driving mechanism being diagrammatically illustrated in Fig. 5. It comprises, in general, a worm 13 meshing with a rack 14 extending lengthwise of the carriage 12 and fixed to the underside thereof. Operatively connected to the worm 13 through a suitable differential gear mechanism 15 are two motors 16 and 17, the motor 16 being adjustable in any well known manner to effect forward feed of the carriage at a desired rate, and the motor 17 being reversible and adapted to effect movement of the carriage in either direction at a rapid traverse rate.

The carriage has a normal position adjacent one end of the bed 10 for loading and unloading of the work pieces, such as the sheet ingots above referred to or the like. In Fig. 1, the numeral 18 represents a sheet ingot clamped in position in the clamping fixture preliminary to advance movement thereof past a rotary cutter 19 (Fig. 2) that is carried by a tool support or head 20 jutting out perpendicularly from the bed 10. The flat slab of metal or ingot 18 is supported on edge in an upright position on a plurality of supporting members 21 (Fig. 1) carried by the carriage 12. The upper edge of the ingot is adapted to be engaged by hydraulically actuated clamping members 22 that are vertically reciprocable in clamping heads 23. The heads are arranged for vertical adjustment on the face of the upstanding wall portion 24 of the carriage, and they are provided with power actuators 25 for moving them into various positions of adjustment. The heads 23 are slidably secured to the wall 24 by suitable means such as T-bolts (not shown) whose heads are disposed in T-slots 26. The clamping members 22 may be arranged in sets, and each set controlled by a manual control lever 27, while the actuating mechanisms for the heads 23 are controlled by manual operating levers 28. Suitable manipulating devices may be

provided to effect loading and unloading operations of the heavy work pieces. Preferably back-up members or abutments (not shown) are provided on the upright wall 24 against which the rear face of the ingot 10 may rest so that the ingot will be properly located for clamping and machining. Of course, the clamping members are in a raised position when an ingot is being loaded onto the carriage, and then they are forced downwardly into clamping engagement with the upper edge of the ingot. After loading, the carriage is advanced to bring the ingot into a gauging position adjacent to the cutter, but with the forward end of the ingot rearwardly of the cutting circle of the cutter.

The cutter 19 (Figs. 2 and 3) is secured to the inner end of a shaft 29 which is journaled in suitable roller bearings 30 within a sleeve 32, a spacer ring 31 being disposed between the bearings 30. Sleeve 32 is recessed at its end adjacent the cutter for the reception of the bearings 30 and the ring 31, and it has attached thereto an end plate 33 which secures the bearings against axial shifting in the sleeve. The inner races of the bearings are engaged by a collar 34 secured to the shaft and shoulder formed integral with the shaft, whereby the shaft is free to rotate within the sleeve 32 but is held against axial movement with respect thereto. The sleeve is slotted at 35 and a pin 33 secured to the tool head 20 extends into the slot. This connection holds the sleeve against rotation, but permits it to slide axially for adjusting the cutter. The outer end of the shaft 29 is operatively connected to a drive motor 37 (Fig. 1) through a plurality of V-type belts 38 and a spline coupling (not shown) which constitute a flexible connection permitting relative axial movement of the cutter shaft and the pulley.

As shown more clearly in Fig. 2, a milling cutter of the face or surfacing type is illustrated and its cutting face is disposed in parallelism with the path of movement of the carriage 12. Normally the cutter is disposed in a back or retracted position and is moved in or forwardly toward the path of carriage travel into predetermined cutting positions.

To produce ingots with two opposite sides scalped, a scalping operation is performed on one side of the ingot after which the ingot is reversed with respect to the cutter and the scalping operation repeated. Hereinafter the respective scalping operations are termed first cut and second cut.

Mounted on the tool head 20 is a gauge or feeler mechanism, indicated generally by the numeral 40, that is operable as a gauge to determine the depth of cut. This mechanism, as illustrated, comprises a feeler 41 in the form of an elongated bar or rod supported for axial sliding movement in a hollow casing or housing 42 which, in turn, is mounted in dovetail guideways 43 in a bracket 44 suitably secured to the side of the tool head. The feeler 41 is held against rotation within the housing 42 by means of a pin 45 (Fig. 2), and it is adapted to be shifted axially by means of a double-acting piston 46 operating in cylinder 47 secured to the outer end of housing 42. The housing 42 is normally disposed in a retracted position, and the feeler 41 is normally projected forwardly relative thereto with a shoulder 43 formed thereon bearing against end plate 49 on the housing. The feeler 41 extends through plate 49 and on its forward end threadedly carries a cap 50 for adjustment

therealong whereby the capped end of the feeler may be adjusted with respect to the face or plane of the cutter. Initially the cap 50 is adjusted into such a selected relationship with respect to the face or plane of the cutter that when the outer or exposed face of the ingot is contacted by the feeler and the feeler mechanism actuated, the active face of the cutter will be positioned a predetermined distance a (Figs. 2 and 4) behind the face of the ingot, for removing a corresponding thickness of metal from the ingot.

The cutter and feeler mechanism are reciprocated in unison by means of a common drive that comprises a motor 51 which rotates a worm 52 meshing with a worm wheel 53. A counter shaft having two sections 54 and 55 coupled by a spline connection 56 is rotated by the worm wheel 53, while pinions 57 and 58 on the shaft sections 54 and 55 mesh, respectively, with racks 59 and 60 secured to the sleeve 32 and feeler housing 42. The cutter and the feeler mechanism are simultaneously advanced until the feeler 41 engages the outer face of the ingot, after which continued movement of the cutter and housing causes relative movement between the feeler and the feeler housing.

This rearward or push-back movement of the feeler 41 is utilized to effect sequential operation of cutter control devices S1 and S2 associated with the control system for the machine, such devices being here illustrated as limit switches. The upper side of the feeler 41 within the housing carries a cam 61 on which rests a roller 62 carried by a motion multiplying link 63 that is pivotally mounted at 64 to the feeler housing. The roller is adapted to be contacted and forced upwardly by the sloping cam surface 65 of the cam 61 as the feeler 41 moves rearwardly within the feeler housing. The free end of the link 63 is engaged at its upper side by a vertically slidable push rod or plunger 66. A guide for the push rod is formed on a bracket 67 secured to the housing 42. Switch S1 is mounted on the bracket 67 with the roller on its operating arm overlying the push rod 66, and switch S2 is adjustably mounted on the bracket 67 with its operating member in position to be engaged by said roller, as shown in Fig. 2. The upper end of the plunger is provided with an adjusting screw 68 for adjusting its length. As the plunger moves upwardly, switch S1 is actuated or tripped to perform its control function of stopping the cutter advance. Its operating arm is capable of overtraveling the tripping point, and such overtravel is effected by further movement of the plunger, and switch S2 is subsequently tripped. Thus, tripping of both switches is responsive to backward movement of the feeler 41. The switch S2 is provided to serve as a protective device to protect the cutter against overloading, as hereinafter pointed out.

It is desirable to retract the feeler 41 after it has performed its control function so as to leave the face of the slab unobstructed for the milling or scalping operation. This is effected by admitting fluid pressure to the cylinder 47 through conduit 69, and after the cutting operation is completed fluid pressure is admitted to the cylinder through conduit 70 to again advance the feeler to its normal position. Since, as herein-after described, this feeler retraction is effected automatically for each cutting operation and results each time in tripping switch S2, the slope of cam surface 65 is designed to require a se-

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lected amount of further travel of the feeler after switch S1 is tripped before the crest or top of the cam is reached, and it is in this further feeler travel that the rise of the plunger effects over-travel of the arm of switch S1 and operation of switch S2. A slope of about 30° to the horizontal has been found practical.

As shown in Fig. 3, means are provided to clamp or lock the cutter in operating position. The locking means comprises a semi-circular clamping member 71 arranged to be clamped tightly against the sleeve 32 to hold it against axial movement. One end of the member 71 is secured in position to the tool head by suitable means such as cap screws 72, while its other end is merely loosely held by screws 73 to permit slight vertical movement. Normally the sleeve can be slid axially with respect to the clamping member. When it is desired to lock the sleeve against such movement, a lever 74 fulcrumed at 75 to a bracket carried by the tool head is pulled downwardly to apply pressure against extension 76 of the clamping member, thereby forcing the member tightly against the sleeve. An operating cylinder 77 having a double-acting piston 78 therein is provided to actuate the link, flow of pressure to and from the opposite ends of the cylinder being effected through conduits 79 and 80.

Because of the importance of providing scalped ingots of identical thickness as heretofore pointed out, it is not possible merely to duplicate the first cut for the second cut in so far as control of the cutter position by the same feeler operation of switch S1 is concerned, since to do so, as heretofore has been the case, results in removing substantially the same thickness of metal from the faces of the ingots on both cuts. Consequently, the variations in the initial thickness of the ingots are reproduced in the scalped ingots. To overcome this problem of variable ingots, control of the cutter for all first cuts is effected by feeler control of switch S1, whereby the same preselected thickness of metal will be removed from each ingot. For second cut, however, the cutter is so controlled independently of switch S1 that it is positioned for removing only that remaining thickness of metal as is required in order to bring the ingot to the desired thickness. Hence, a greater or lesser thickness of metal may be removed at the second cut than at the first cut. The cutting sequence and operating conditions are illustrated in Fig. 4 wherein X represents the initial thickness of the ingots and Y the desired thickness of the scalped ingots, Z representing the occasional ingots that may be too thick initially to be scalped with but two cuts without overloading and possibly damaging the cutter knives.

For the first cut, the cutter and feeler mechanism advance in unison until the feeler 41 engages the ingot and is relatively pushed back in its housing. Thereby the sloping cam surface 65 is traversed by the roller 52 to force lever 63 and plunger 66 upwardly until switch S1 is tripped. Actuation of the switch through circuits to be described causes the drive motor 51 to stop and the cutter clamp to be actuated so that the cutter is positioned the distance a behind the ingot. After the cut a thickness of metal b remains to be removed on the second cut to reduce the ingot to the desired thickness Y. It is to be noted that the thickness of metal remaining to be removed will vary in accordance with the variations in the initial thickness of the ingots. Hence, b may

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be less than a or it may be greater than a as represented at c .

For the second cut, the switch S1 is rendered ineffective or cut out of the control circuit and control of the cutter is transferred to a control device illustrated in Fig. 2 as switch S3, which is adapted to be actuated in response to cutter advance into a position in which the distance between its active face and the plane of the back face of the ingot in the clamping fixture is equal to Y. Switch S3 preferably is mounted on the side of the tool head 20 in a fixed position and an adjustable operating member 81 is provided therefor in the form of a screw that is threaded through a plate 82 suitably attached to the underside of housing 42. Switch S3 is operable to stop and to clamp the cutter; and, since the feeler housing has identical motion with the cutter, switch S3 may be tripped to stop the cutter repeatedly in the same position without reference to the remaining thickness of the ingot so that with a given adjustment of the operating member 81 the ingots will be of identical thickness after the second cut.

In order that switch S1 may be rendered ineffective, suitable means such as a manually operable two-position selector switch or controller CS (Fig. 5) is provided. When the controller is moved to its No. 1 position, switch S1 will be operable in the control circuit, but when the controller is moved to its No. 2 position, switch S1 will be cut out of the control circuit. In its neutral or off position the controller renders the entire control system inoperative.

With reference to Fig. 2, it is to be noted that the cutter advance on the first cut with S1 in circuit will be terminated by feeler actuation of switch S1 before screw 81 reaches the control device S3 as indicated by the dotted line position of the parts. This is because no metal as yet has been removed from the ingot, it being assumed that all ingots are of an original thickness X, greater than Y (Fig. 4). On second cut with S1 cut out of the circuit, advance of the cutter and feeler is effected until the motion is terminated by operation of either switch S3 or switch S2 dependent upon feeler measurement of the thickness of the ingot. During this second cut advance the feeler engages the ingot and is pushed back as before, thereby gauging the thickness of the ingot. Ordinarily switch S3 is tripped before the feeler is pushed back far enough to effect actuation of switch S2. In this connection it is pointed out that it is possible to effect a greater depth of cut on second cut than that for which the feeler is set to determine, since, as above explained, the feeler is required to be moved a selected distance past the tripping point of switch S1 before switch S2 will be operated. This allows substantial variations in ingot thickness after the first side has been scalped to be removed in one pass from the other side of the ingot at the second cut. However, in case the second cut thickness is excessive as indicated by c , Fig. 4, the feeler will cause switch S2 to be tripped prior to actuation of switch S3 to set up an emergency return circuit for the cutter and thereby indicate that the depth of cut is too great.

Referring to Fig. 5, the control system illustrated incorporating the cutter control provides automatic cyclic operation of the machine tool following the loading of the ingot in the clamping fixture in its loading position. The cycle of operation for the first cut cycle will now be de-

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scribed in detail. First, however, it may be mentioned that the various control circuits will be energized from suitable electric supply lines which for simplification are represented in the drawing by the polarity symbols positive (+) and negative (−) in a circle and referred to in the following description as P and N, respectively. In addition to the cutter control devices heretofore mentioned, S1, S2, and S3, a switch S4 is associated with the feeler mechanism and is adapted to be actuated by a dog 85 on the housing 42 to terminate retractive movement of the cutter and feeler mechanism. Switches S5, S6, and S7 are associated with the traveling clamping fixture for actuation by trip members or dogs 86, 87, and 88, respectively. A 4-way solenoid operated valve 90 is provided by means of which fluid pressure from a suitable source is supplied to the pistons 65 and 70. Solenoid 91 when energized moves the slide element of the valve (not shown) to the left so that pressure fluid flows from pressure line 92 past the valve through common conduit 93 and conduits 69 and 79 to clamp the cutter and to retract the feeler away from the face of the ingot. Exhaust is effected at this time through conduits 70—80 and common conduit 94 past the valve to exhaust line 95. Solenoid 96 pulls the slide element of the valve to the right to reverse the connections, thereby actuating the clamp to release the cutter and projecting the feeler forwardly into normal position. The slide element of the valve remains in either of its operating positions until it is shifted to its other position so that the solenoids need be energized only momentarily. Contactor switches or relays A51 and R51 are provided for connecting the motor 51 to supply lines L1, A51 when energized effecting cutter advance and R51 when energized effecting cutter retraction. Contactor switches or relays A17 and R17 are provided to connect the rapid traverse motor 17 to supply lines L2, contactor A17 controlling the motor to cause advance of the carriage 12 and contactor R17 controlling the motor to effect return travel of the table 12. A contactor C5 is provided to connect the feed motor 16 to D. C. supply lines L3. In addition, control relays CR1, CR2, and CR3 are provided to effect certain control operations.

With the controller CS in its No. 1 position and table 12 in loading position with an unscalped ingot 13 clamped thereon, start switch 97 is depressed to initiate the first cut cycle, whereby CR3 is energized (P at CR2—100—97—CS—101—CR3—N). At this time the cutter and the feeler mechanism are in their retracted positions. CR3 energizes valve solenoid 96 to insure release of the cutter and projection of the feeler in its housing (P at CR3—102—96—N) and completes a circuit for A17 (P at S3—103—S1—104—98—135—S4—106—S5—107—CR3—108—R17—A17—N). A17 is thus energized to cause rapid advance of the carriage 12, and it is held in by closure of its contacts 109 so that the start switch 97 may be released and CR3 de-energizes.

The table travels rapidly toward gauging or feeling position and is stopped in such position when adjustable dog 87 on the carriage hits switch S6 and opens a point in the above traced circuit for A17 so that the motor 17 is disconnected from the line L2. As the table moves away from loading position, dog 86 releases switch S5 so that later the table may be returned. Switch S6 when actuated by dog 87 also completes a circuit for the A51 contactor whereby the motor 51 is connected to line L1 and advancing movement is im-

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parted to the cutter and feeler mechanism. A51 is energized through a circuit P at S3—103—S1—104—S6—110—CR1—116—A51—111—CR2—N. This circuit remains effective so long as switch S1 remains in its normal position. It is to be remembered that S1 is actuated in response to push-back movement of the feeler, and when this occurs the circuit for A51 is opened whereby advance of the cutter is terminated with the cutter in a cutting position determined by the initial thickness of the ingot 18. Preferably an electromagnetically operated brake (not shown) is operatively associated with the motor 51 and is actuated upon release of A51 to prevent over-travel of the cutter.

Actuation of switch S1 also energizes control relay CR2 (P at S7—112—CS—113—S1—114—CR1—115—CR2—N). As a result positive is removed from conductor 150 so that CR3 cannot be energized and another point in the circuit of A51 is opened. It also completes a circuit for energizing the clamping solenoid 91 (P at CR2—117—91—N). Thereby valve 90 is actuated to the left and pressure admitted to the conduits 79 and 69 which causes the clamp 71 to be actuated and the feeler 41 to be retracted from the face of the ingot. As a result of the full retraction of the feeler, switch S2 will be actuated, but at this time nothing will happen because CR2 is energized and there is no positive on the circuit. Closure of switch CR2 also completes a circuit P at CR2—120—C5—N) and by energization of contactor C5 the feed motor 16 is connected to the supply line L3. Thereby feeding movement of the carriage at a desired slow rate of feed is initiated to move the ingot into contact with and past the cutter 19. Consequently, the exposed face of the ingot will be scalped, a predetermined thickness of metal being removed. Movement of the dog 87 past switch S6 allows the limit switch to return to normal position, thereby opening another point in the circuit of the cutter advancing contactor A51, and closing a point in the circuit for the rapid advance contactor A17. It is to be noted, however, that A17 cannot be energized at this time because its original energizing circuit is open at S4, this switch being released by the dog 85 at the start of the advancing movement of the feeler mechanism.

Slow feed of the ingot past the cutter continues until the entire length of the ingot is scalped, whereupon adjustable dog 88 on the carriage trips the limit switch S7. As a result positive is removed from the energizing circuit of relay CR2 and this relay drops out, thereby opening the circuit for the clamping solenoid 91 and opening the energizing circuit for the contactor C5. Feed movement of the carriage is thus terminated. In addition, operation of switch S7 completes a circuit (P at S7—123—CR1—N) for the CR1 relay. It may be noticed at this point that a parallel circuit for the CR1 relay extends through switch S2 through conductor 124—CR2—P so that the CR1 relay can be energized independently of the limit switch S7 whenever the control relay CR2 is in a de-energized condition.

Energization of CR1 opens another point in the circuit of the relay CR2 and it completes a circuit for the solenoid 96 (P at CR—125—102—96—N) so that again the cutter will be released for retraction and the feeler projected into forward position in the feeler housing. Relay CR1 also completes a point in the circuit of the rapid

return contactor R17 but contactor R17 will not be energized because the feeler mechanism and the cutter have not yet been retracted. Such retraction is effected by energization of the contactor R51 (through a circuit P at S4-126-CR1-127-R51-111-CR2-N) whereby the motor 51 is connected across the line L1 and driven in a direction to retract the cutter. Retraction is terminated when dog 85 actuates switch S4 to remove positive from the above traced circuit of the contactor R51. Actuation of switch S4 also completes the circuit for the contactor R17 (P at S3-103-S1-104-stop switch 98-105-S4-106-S5-128-CR1-129-R17-N). This contactor picks up and completes a holding circuit for itself at contacts 130 so that it will be held in after de-energization of the relay CR1 which occurs when dog 88 releases S7 upon retraction of the carriage. The contactor R17 connects the rapid traverse motor 17 to the line L2 so that the carriage is rapidly returned to its loading position. When it reaches loading position further movement is prevented by the dog 86 tripping switch S5, thereby opening the holding circuit for the contactor R17 which drops out and motor 17 is disconnected from the line. This completes the first cut cycle.

After reversing the ingot in the carriage and reclamping it with its opposite face exposed for scalping, the second cut cycle is initiated. First, the controller CS is moved from its No. 1 position to its No. 2 position and then the start switch 97 is momentarily depressed. The same cycle of operation as heretofore described will take place except that by reason of movement of controller CS to its No. 2 position, control of the cutter advance is effected by means of switch S3 instead of S1. The normally closed contacts of switch S1 are shunted by a circuit extending through the controller, the shunt circuit extending from conductor 103 through 131-CS-132 to a common point between stop switch 98 and open contacts of switch S6. Therefore, when the cutter and the feeler are being advanced, such advance will continue until the operating member 81 trips switch S3 to open the circuit of the cutter advancing contactor A51 (this circuit is P at S3-103-131-CS-132-S6-110-CR1-116-A51-111-CR2-N). Also, since the selector switch cuts out the circuit extending through the normally open contacts of switch S1, relay CR2 will not be energized by operation of switch S1, but only by operation of switch S3 (through a circuit P at S7-133-S3-134-114-CR1-115-CR2-N). Hence, the feeler mechanism and the cutter may be advanced beyond the point at which switch S1 would normally be actuated by push-back of feeler 41. Thus, when switch S3 is actuated, advance of the cutter is terminated with the active face of the cutter spaced a preselected distance away from the plane of the rear or previously scalped face of the ingot, the cutter clamp is actuated, and slow feed of the ingot past the cutter is initiated. After the cut is completed, the cutter clamp is released, the cutter is retracted, and the table is rapidly returned to normal position in the same manner as heretofore described. The second cut cycle is thereby completed with the ingot scalped to a selected desired thickness.

As heretofore explained, the thickness of metal to be removed on the second cut may be excessive and cause the switch S2 to be actuated during push-back of the feeler 41 before switch S3 is actuated. As a result a safety circuit to

return the cutter is completed (P at CR2-124-S2-CR1-N), CR2 being de-energized at this time because the feeler and cutter are advancing. At this time relay CR1 operates to complete the heretofore traced circuit for the cutter return control relay R51. It also opens a point in the circuit of the contactor A51. As a result R51 picks up and A51 drops out and the cutter begins to retract. During this retraction of the cutter and the feeler housing, the plunger 66 will descend and allow the switch S2 to open. Thereby the relay CR1 is de-energized so that R51 drops out and A51 again picks up to effect advancement of the cutter. Naturally the operations will again recur whereby an oscillating motion will be imparted to the cutter. This indicates to the operator that the thickness of the metal to be removed is too great to be removed at one cut. He will return the controller CS to its No. 1 position, thereby allowing the cutter to be moved under feeler control to a position in which it will remove a thickness of metal corresponding to δ . The remainder of the machine tool cycle is continued to completion. Then, instead of reversing or removing the ingot from the carriage, the controller will be moved to No. 2 position and the second cut cycle of operation effected on the ingot to remove the remaining metal to reduce it to the desired thickness Y.

From the foregoing it will be seen that sequentially operative cutter control mechanism has been provided for automatically scalping ingots of varying nominal thickness to a uniform thickness. While a particular embodiment of the invention has been illustrated, it will be understood that various equivalent means may be substituted for those specifically disclosed herein and variations in the particular system disclosed employed without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a machine tool of the type described, a rotary cutter, a feeler associated therewith, power means for moving said cutter and said feeler in unison toward a work piece disposed forwardly thereof but outside the circle described by said cutter, said feeler being adapted to engage the outer face of said work piece whereby its forward motion is terminated while said cutter continues to advance relative to said feeler into a cutting position behind the plane of the outer face of said work piece, control means operable responsively to said relative movement between said cutter and said feeler for stopping said power means with said cutter in a feeler determined position with respect to said outer face of said work piece, control means responsive solely to cutter advance for stopping said power means with said cutter in a fixed distance relation with respect to the inner face of said work piece, and means for rendering each of said control means operable alternately in the order named in a first cut and a second cut sequence on opposite faces of said work piece respectively.

2. In a machine tool of the type described, a rotary cutter, a feeler associated therewith, reversible power means for moving said cutter and said feeler in unison toward a work piece disposed forwardly thereof but outside the circle described by said cutter, said feeler being adapted to engage the outer face of said work piece whereby its forward motion is terminated while said cutter continues to advance relative to said feeler

into a cutting position behind the plane of the outer face of said work piece, control means operable responsively to said relative movement between said cutter and said feeler for stopping said power means with said cutter in a feeler determined position with respect to said outer face of said work piece, other control means responsive solely to cutter advance for stopping said power means with said cutter in a fixed distance relation with respect to the inner face of said work piece, means for rendering each of said control means operable in a first cut and a second cut sequence, and a third control means actuated by said feeler in response to said relative cutter and feeler movement in excess of a preselected extent for rendering said cutter inoperative.

3. In apparatus for scalping opposite sides of an ingot or the like in a first cut and a second cut sequence, in combination, an ingot support, a power driven cutter, means for relatively translating said support and said cutter past each other to effect a scalping operation, reversible power means by which said cutter is bodily advanced for adjusting its cutting position relative to said ingot for each scalping operation, a feeler engageable with said ingot during said cutter advance and adapted for push-back movement relative to said cutter, a control device for said power means actuated by said feeler responsively to said push-back movement to discontinue advance of the cutter with said cutter positioned to remove a layer of metal of predetermined thickness from said ingot for said first cut, means for rendering said control device inoperative for subsequent advance of the cutter into position for the second cut, control means for said power means actuated in response to said subsequent cutter advance to interrupt the latter when the cutter reaches a position in which the distance between its active face and the plane of the back face of said ingot is equal to a predetermined ingot thickness, whereby on second cut a layer of metal will be removed equal to the difference between said predetermined ingot thickness and the thickness of the ingot remaining after the first cut, and feeler actuated means operable upon push-back movement thereof a preselected extent past the point at which it normally actuates said control device for reversing said power means to effect withdrawal of said cutter in the event said feeler actuated means is actuated prior to actuation of said cutter control means.

4. In apparatus for scalping ingots and the like in a first cut and a second cut sequence for opposite sides thereof, in combination, a surfacing cutter, an ingot clamping fixture having a loading station and a gauging station at one side of said cutter, means for translating said fixture from said loading station to said gauging station, power means for moving said cutter transversely into cutting position, feeler means associated with said cutter for engaging the exposed side of the ingot in said gauging station during power movement of said cutter, alternate control means for said power means responsive, respectively, to actuation of said feeler after said engagement with said ingot, and solely to said movement of the cutter, whereby said cutter is selectively positioned in either a first cut or a second cut operating position automatically, selector means for selectively rendering one or the other of said control means operative, and means rendered operable by actuation of either of said control means for locking said cutter in operating position and initiating movement of said clamping

fixture from said gauging station, to carry the ingot past said cutter.

5. In a machine tool of the type described, the combination of a tool head, a rotary cutter mounted thereon for axial shifting movement, a feeler mechanism slidably mounted on said tool head for movement paralleling that of said cutter, said mechanism including a housing and a feeler movably supported therein and normally in forwardly projected position with its outer end disposed in preadjusted relation relative to the active face of said cutter, common drive means for simultaneously advancing said feeler mechanism and said cutter toward a work piece disposed forwardly thereof in position to be engaged by said feeler but outside the circle described by said cutter, whereby said feeler after engaging said work piece is relatively pushed back in said housing while said cutter and said housing continue to advance, a first control device for said drive means mounted on said housing, a cam on said feeler, means actuated by said cam upon said push-back movement of said feeler for operating said control device, to stop said advance with said cutter located to remove a measured thickness of metal from said work piece, another control device for said drive means mounted on said tool head, an adjustable operating member carried by said housing for actuating said other control device, to stop said cutter advance with the cutter spaced a predetermined distance from the rear side of said work piece, and means for rendering said first control device inoperative when said other control device is utilized to control the position of said cutter.

6. In a machine tool of the type described, the combination of a tool head, a rotary cutter mounted thereon for axial shifting movement, a feeler mechanism slidably mounted on said tool head for movement paralleling that of said cutter, said mechanism including a housing and a feeler movably supported therein and normally in forwardly projected position with its outer end disposed in preadjusted relation relative to the active face of said cutter, common drive means for simultaneously advancing said feeler mechanism and said cutter toward a work piece disposed forwardly thereof in position to be engaged by said feeler but outside the circle described by said cutter, whereby said feeler after engaging said work piece is relatively pushed back in said housing while said cutter and said housing continue to advance, and means for controlling the operation of said drive means during said advancing movement comprising a first control device mounted on said tool head in a fixed position and second and third control devices mounted on said housing, an adjustable operating member on said housing for actuating said first control device, a cam on said feeler having a sloping cam surface, lever means having a roller for traversing said cam surface upon said relative push-back of said feeler for actuating said second and third control devices sequentially, dependent upon the extent of said feeler push-back, said second control device being effective to locate said cutter in position for removal of a predetermined thickness of metal from the work piece for the first cutting operation thereon, said first control means being effective to locate said cutter in a position spaced a predetermined distance from the rear side of the work piece, for the second cutting operation thereon, and means for transferring control from said second control device to said first and third control devices for said sec-

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and cutting operation, said third control device being operable to effect withdrawal of said cutter in the event it is actuated prior to actuation of said first control device.

7. A machine for scalping ingots and the like in which a cutter is advanced from a retracted position under control of a feeler actuated control device that advances in unison with the cutter until the feeler engages the outer face of an ingot to be scalped and thereafter effects operation of said control device to terminate the advancing movement with the cutter located a predetermined distance behind said outer face for removing a corresponding thickness of metal from said ingot during subsequent movement thereof past said cutter, after which the ingot is reversed so that its opposite face may be scalped, characterized by the combination with said control device, of means for rendering it ineffective prior to scalping said opposite face of the ingot, and means controlled by said cutter and rendered effective by operation of said last named means for terminating advance of said cutter when it reaches a preselected position spaced a fixed distance away from the rear face of said ingot, whereby after scalping said opposite face the ingot will be of a predetermined thickness, said last named means comprising a second control device mounted in fixed position relative to forward travel of the cutter, and an operating member movable in unison with said cutter for actuating said second control device.

8. In a machine for scalping ingots and the like wherein a cutter and a feeler advance simultaneously until the feeler engages the outer face of an ingot to be scalped whereupon a control device associated with the feeler is actuated by the feeler to terminate said advance with the active face of said cutter located a predetermined distance behind said face of the ingot for removing a corresponding thickness of metal from the ingot during subsequent movement thereof past said cutter, after which the ingot is reversed so that its opposite face may be scalped, the combination with said control device, of a second control device for said cutter mounted in a fixed position relative to forward travel of the cutter and operable to terminate cutter advance with the

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active face of said cutter spaced a predetermined distance from the rear face of said ingot, an adjustable operating member movable in unison with said cutter for actuating said second control device, switching means effective to transfer control of the cutter from said feeler actuated control device to said second control device, whereby positioning of the cutter for scalping said opposite face of the ingot is controlled by said second control device, means responsive to actuation of either of said control devices for clamping said cutter in its respective cutting positions, and for initiating movement of the ingot past said cutter, and means actuated by overtravel of said feeler after its engagement with said opposite face of the ingot for preventing operation of said last named means.

9. In a machine for scalping ingots and the like, a rotary surfacing cutter, means for advancing the cutter from a retracted position into a forward cutting position for each scalping operation on an ingot, clamping means for said cutter, electrical control means including a first and a second control switch for stopping said advancing means and actuating said clamping means, means for actuating said first switch to stop and lock said cutter in a first cutting position with respect to the outermost face of said ingot, means for actuating said second switch only after said cutter is advanced past said first cutting position to stop and lock said cutter in a second cutting position spaced a fixed distance away from the rear face of said ingot, and switching means effective for rendering each of said switches operable alternately in a first cut and a second cut sequence on opposite faces of said ingot, respectively, said ingot being reversed after scalping of one face thereof to present its opposite face outwardly for scalping.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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