Sept. 22, 1964 G. L. ANDERSEN 3,149,519

METHOD AND APPARATUS FOR DETERMINING THE VOLUME OF SLUGS CUT OFF FROM IRREGULAR BAR STOCK

Filed Jan. 16, 1961 4 Sheets-Sheet 1

FIG.1.

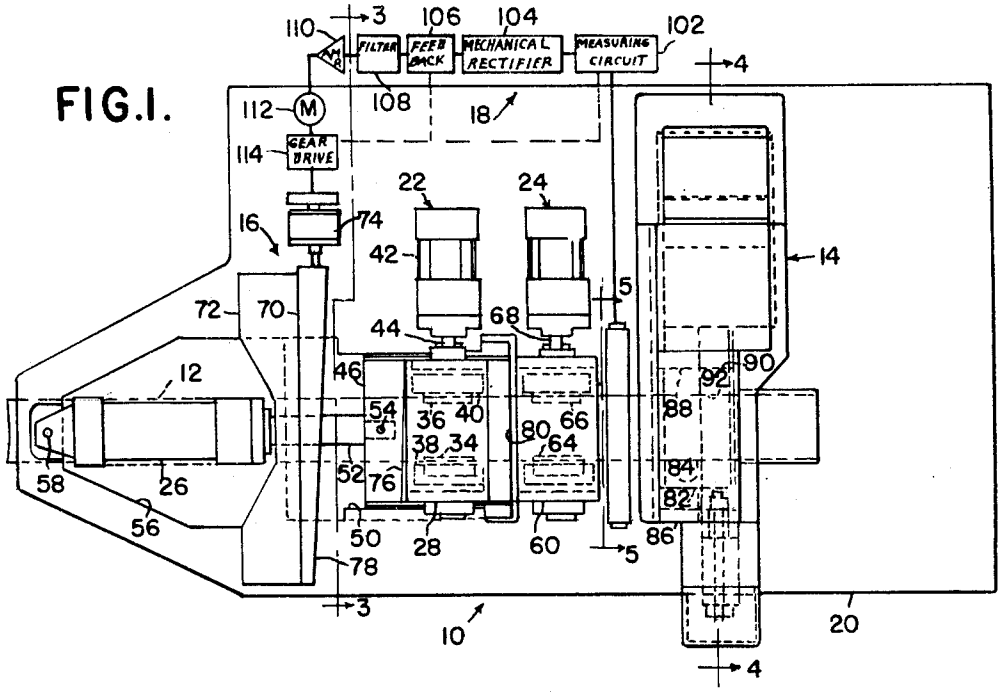
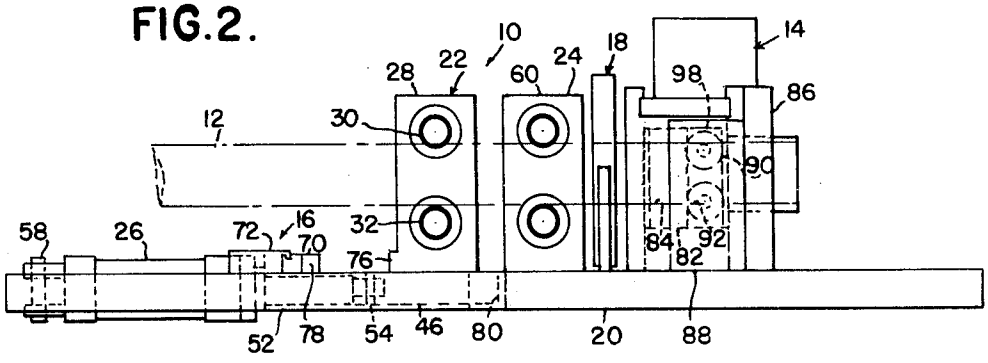


FIG.2.



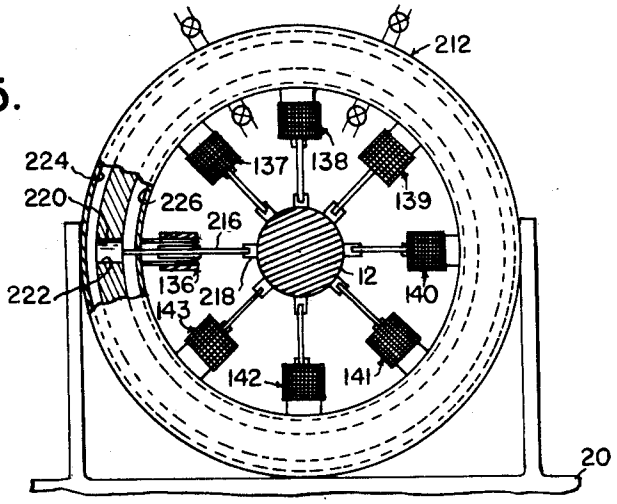
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FIG.5.



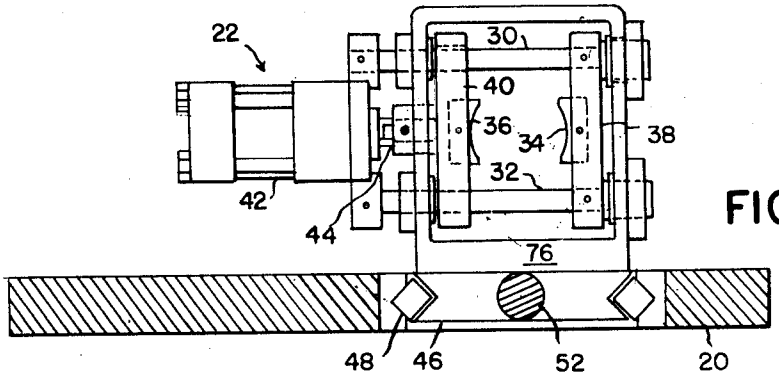
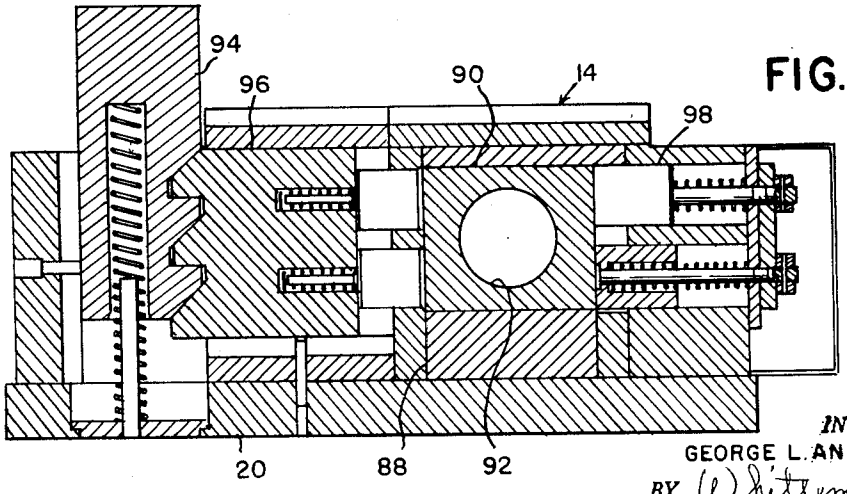


FIG.3.

FIG.4.



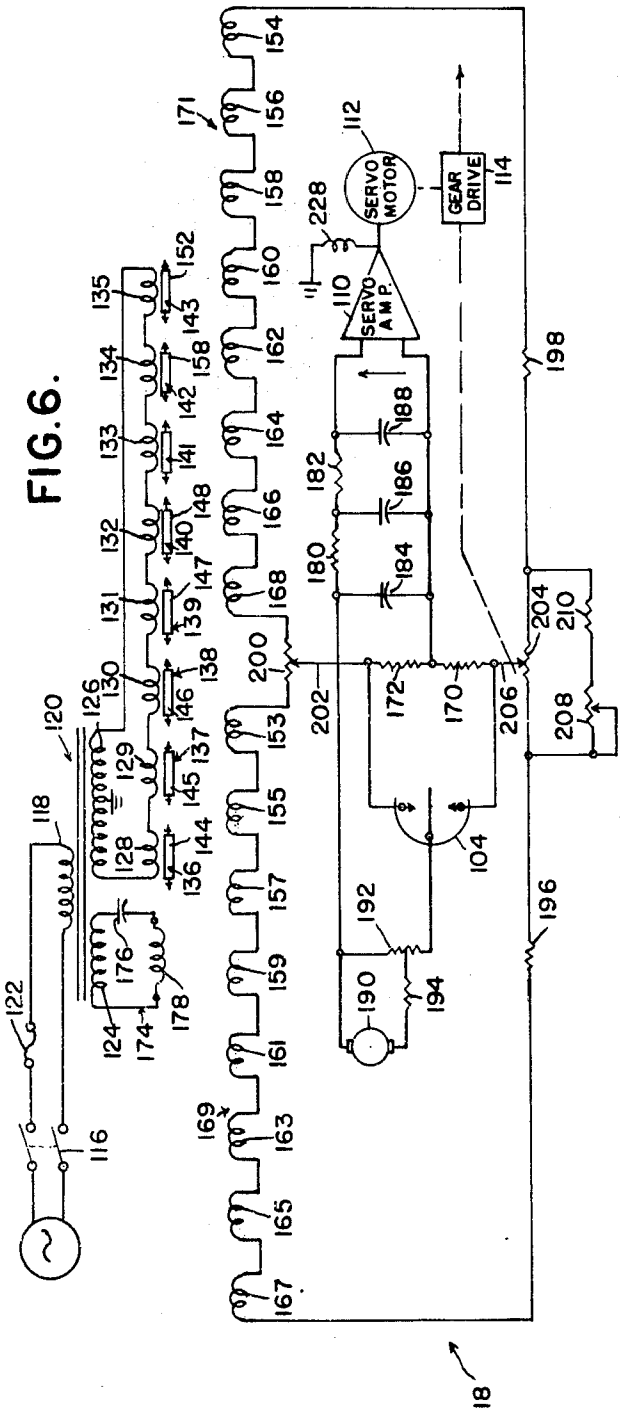
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METHOD AND APPARATUS FOR DETERMINING THE VOLUME OF SLUGS CUT OFF FROM IRREGULAR BAR STOCK

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FIG. 6.



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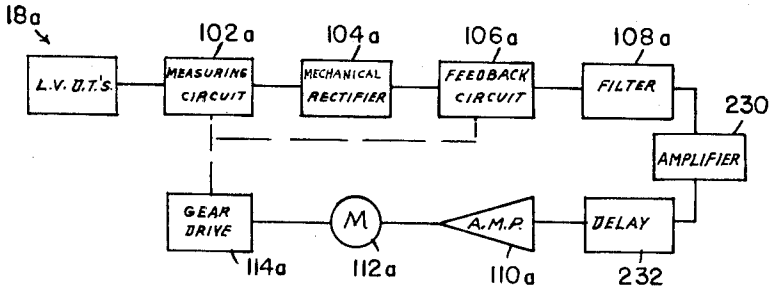
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METHOD AND APPARATUS FOR DETERMINING THE VOLUME OF SLUGS CUT OFF FROM IRREGULAR BAR STOCK

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FIG.7.



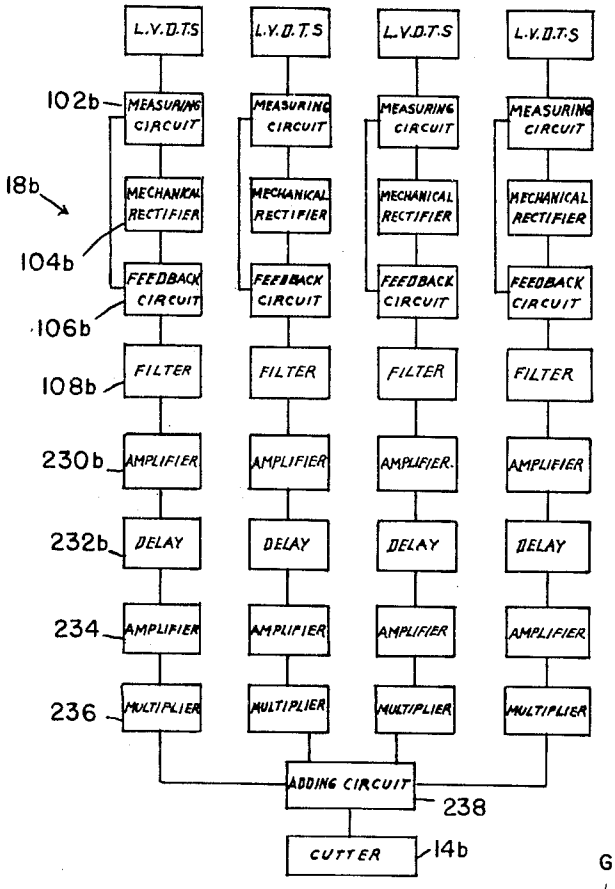


FIG.8.

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United States Patent Office 3,149,519 Patented Sept. 22, 1964

3,149,519

METHOD AND APPARATUS FOR DETERMINING THE VOLUME OF SLUGS CUT OFF FROM IRREGULAR BAR STOCK

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Filed Jan. 16, 1961, Ser. No. 82,790
7 Claims. (Cl. 83—209)

The invention relates to method and apparatus for producing slugs of predetermined volume from irregular bar stock and refers more specifically to means for and the method of sensing the cross sectional area of bar stock fed to a cutter and controlling the length of bar stock fed to the cutter in accordance with the sensed cross sectional area so that on operation of the cutter slugs having a predetermined volume are cut from the bar.

In cold forming metal parts from slugs of metal it is essential that the slugs have the proper volume since slugs having less volume than required will produce defective articles while slugs having too large a volume may damage the forming dies.

In the past expensive grinding apparatus has been used to grind bar stock to a predetermined cross section so that slugs having the proper volume could be cut therefrom by cutting the bar at predetermined intervals. Such grinding and measured cutting is expensive, time consuming and tedious.

It is therefore one of the objects of the present invention to provide an improved method of producing slugs of predetermined volume from bar stock of irregular cross section.

Another object is to provide improved means for producing slugs of predetermined volume from bar stock of irregular cross section.

Another object is to provide a method of producing a slug of predetermined volume comprising sensing the cross sectional area of bar stock of irregular cross section and cutting a slug from the bar having a length related to the sensed cross sectional area to provide a slug of predetermined volume.

Another object is to provide a method of producing a slug of predetermined volume set forth above wherein the step of cutting the slug from the bar stock is delayed with respect to the sensing of the cross sectional area so that the sensed cross sectional area is centrally located in the slug cut from the bar whereby the sensed cross sectional area is substantially the average cross sectional area of the slug.

Another object is to provide a method of producing a slug of predetermined volume from bar stock having an irregular cross section comprising sensing a plurality of adjacent cross sectional areas of the bar stock, multiplying the sensed cross sectional areas by a factor determined by the spacing between the areas, adding the plurality of volumes thus obtained until the total volume equals the predetermined volume, and cutting the slug containing the sensed cross sectional areas from the bar.

Another object is to provide means for producing a slug of predetermined volume from bar stock having an irregular cross section comprising a cutter, means for feeding a length of bar stock into the cutter, means for sensing the cross sectional area of the bar stock fed to the cutter, and means for adjusting the length of bar stock fed to the cutter in accordance with the sensed cross sectional area to produce slugs of a given volume on operation of the cutter.

Another object is to provide means for producing a slug of predetermined volume from bar stock as set forth

above including delay means for delaying the adjustment of the length of bar fed to the cutter due to sensing of a particular cross sectional area of the bar until a slug having the particular sensed cross sectional area of the bar therein is positioned to be cut from the bar.

Another object is to provide means for producing a slug of predetermined volume from bar stock having an irregular cross section comprising a cutter, means for feeding a length of bar stock into the cutter, a plurality of sensing means for sensing a plurality of adjacent cross sectional areas of the bar, means for multiplying the sensed cross sectional areas by a factor determined by the distance between the cross sectional areas sensed, means for adding the volumes thus obtained, and means for operating the cutter when the added volumes reach a predetermined value representative of a slug of the predetermined volume.

More specifically it is an object of the present invention to provide a method of producing slugs of predetermined volume from bar stock of irregular cross section comprising developing an electric signal representative of the cross sectional area of the bar stock, positioning a stop operable to determine the length of bar stock fed to a cutter in accordance with the developed electric signal, feeding the determined length of bar stock into the cutter and cutting the slug therefrom.

More specifically it is an object of the present invention to provide means for producing slugs of predetermined volume from bar stock of irregular cross section comprising means for feeding a length of bar stock into a cutter, a stop positionable to determine the length of bar stock fed into the cutter, electronic means for developing a signal representative of the cross sectional area of the bar stock, and means for positioning the stop in accordance with the developed signal so that the length of bar stock fed into the cutter will produce a slug of predetermined volume on operation of the cutter.

Another object is to provide a method and apparatus for producing slugs of predetermined volume from irregular bar stock which are simple, economical and efficient.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating preferred embodiments of the invention, wherein:

FIGURE 1 is a top view of apparatus for producing slugs of predetermined volume from bar stock having irregular cross section in accordance with the invention.

FIGURE 2 is a side view of the apparatus illustrated in FIGURE 1.

FIGURE 3 is a cross section of the apparatus illustrated in FIGURE 1 taken on the line 3—3 in FIGURE 1.

FIGURE 4 is a cross section of the apparatus illustrated in FIGURE 1 taken on the line 4—4 in FIGURE 1.

FIGURE 5 is a cross section of the apparatus illustrated in FIGURE 1 taken on the line 5—5 in FIGURE 1.

FIGURE 6 is a schematic diagram showing in detail parts of the control circuit illustrated in FIGURE 1.

FIGURES 7 and 8 are block diagrams of modified control circuits for use with apparatus similar to that of FIGURES 1–5 for producing slugs of predetermined volume from bar stock having an irregular cross section.

With reference to the drawings a specific embodiment of the present invention will now be disclosed.

As shown in FIGURES 1–5, the invention comprises means 10 for feeding bar stock 12 into cutter 14. The length of the bar stock 12 fed to cutter 14 during a single cycle of means 10 is determined by the spacing means 16. In accordance with the invention the spacing means 16 is controlled by the electronic control circuit 18 shown best in FIGURES 6 and 7.

More specifically the means 10 for feeding bar stock 12 to cutter 14 comprises base plate 20, gripping means 22 and 24, cylinder 26 and spacing means 16. Base plate 20 may be constructed of metal in the form shown best in FIGURE 1 to provide support for the other members of means 10, the cutter 14, and the electronic control circuit 18.

The gripping means 22 comprises a frame 28 having rods 30 and 32 journaled therein as shown in FIGURE 3. Rods 30 and 32 support gripping members 34 and 36 therebetween on fixed cross member 38 and slidable cross member 40 respectively, as shown in FIGURE 3. Actuating cylinder 42 is secured to frame 28 as shown. Piston rod 44 extends from cylinder 42 through frame 28 and is rigidly secured to member 40 as shown whereby on extension of the piston rod due to actuation of cylinder 42 the gripping members 34 and 36 are caused to engage and securely hold bar stock 12 placed therebetween.

The frame 28 of gripping means 22 as shown best in FIGURE 3 is supported on guide plate 46 for sliding movement therewith along guideways 48 which are supported in opening 50 in base plate 20. Cylinder 26 having piston rod 52 extending therefrom which piston rod is secured to the guide plate 46 by means of pin 54 provides means for moving gripping means 22 along guideways 48. Cylinder 26 is secured to base plate 20 in an opening 56 cut therein by means of pin 58 as shown best in FIGURE 1.

Gripping means 24 is similar to gripping means 22 except that the frame 60 therefor is rigidly secured to the base plate 20 in the position illustrated best in FIGURE 2. Cylinder 62 functions to cause gripping members 64 and 66 to grip bar stock positioned therebetween when piston rod 68 is extended and to release the bar stock when the piston rod 68 is retracted in the same manner as described in conjunction with gripping means 22.

Spacing means 16 includes sine bar 70 secured to base plate 20 by bridge 72 for sliding movement transverse to the axis of the bar stock 12 held in gripping means 22 and 24. Sine bar 70 may be positioned transversely of bar stock 12 by adjusting means 74 which may be actuated either manually or by means of the electronic control circuit 18 as will later be seen.

Frame 28 of gripping means 22 is provided with a tapered surface 76 as shown best in FIGURE 1 operable to abut the tapered surface 78 of the sine bar 70 on retraction of the piston rod 52. Thus the retraction of piston rod 52 is variably limited by the transverse position of the sine bar 70 with respect to the bar stock 12.

The operation of the apparatus thus far described is cyclic and may be timed by means of a rotating cam wheel (not shown) which is operable to sequentially open and close hydraulic valves to cylinders 22, 24 and 26 in a predetermined sequence in time with the operation of the cutter 14 as will be readily understood by those in the art.

In sequence of operation of the means 10 it will first be assumed that bar stock 12 from which a slug has just been cut by cutter 14 is rightly gripped by gripping members 64 and 66 due to extension of piston rod 68 of gripping means 24 and that piston rod 44 of gripping means 22 is extended so that the bar stock is also gripped by gripping means 34 and 36. In addition it will also be assumed that the piston rod 52 is extended so that gripping means 22 abuts forward stop 80 provided therefor.

Piston rod 44 is then retracted whereby gripping means 34 and 36 release the bar stock. Piston rod 52 is retracted to move gripping means 22 into a position whereat the tapered surface 76 of frame 28 abuts the tapered surface 78 of sine bar 70. Piston rod 44 is next extended whereby gripping means 34 and 36 grip the bar stock. Piston rod 68 is then retracted so that the bar stock is released by gripping means 64 and 66 and piston rod 52

is extended whereby the gripping means 22 and the bar stock gripped thereby is moved forward a distance determined by the distance between the surface 78 of the sine bar at the centerline of bar stock 12 and the fixed stop 80.

Thus a length of bar stock 12 which length is predetermined by the transverse setting of the sine bar 70 is fed into the cutter 14. Piston rod 68 is then extended so that gripping members 64 and 66 also grip the bar stock 12 to firmly hold the bar stock while the predetermined length thereof is removed therefrom by means of cutter 14.

Cutter 14 as shown best in FIGURES 1 and 4 comprises a fixed cutting block 82 having an opening 84 therein through which the bar stock is allowed to pass which block 82 is held in position in frame 86 by convenient means such as blocks 88. Cutter 14 also includes a movable cutting block 90 also having therein an opening 92 through which the bar stock is permitted to pass. Cutting block 92 is movable relative to cutting block 82 to shear slugs from bar stock 12 inserted in cutter 14.

As shown in FIGURE 4 cutter 14 may be operated by reciprocal movement of cam member 94 which is spring loaded in the position shown in FIGURE 4. Movement of cam member 94 toward base plate 20 causes cam follower 96 to move toward the cutting block 92 to shear slugs from bar stock 12. Cutting block 92 is also spring loaded by means 98 to return to the position shown in FIGURE 4.

The cam means 94 may be operated in sequence with the operation of cylinders 25, 42 and 62 by the rotating cam wheel previously mentioned so that cutting of a slug from the bar stock 12 will be accomplished only after a predetermined length thereof has been inserted in cutter 14 and the bar stock is firmly held in position for cutting.

The electronic control circuit 18 previously mentioned is provided in accordance with the invention to sense the cross sectional area of the bar stock inserted in cutter 14 as determined by the average diameter of the bar stock and to adjust the sine bar 70 laterally in accordance with the sensed cross sectional area so that the length of bar stock inserted in cutter 14 during each cycle of operation of means 10 will provide a slug of predetermined volume on operation of the cutting means 14.

The control circuit 18 as shown partly in block diagram form in FIGURE 1, comprises eight linear variable differential transformers 136–143 positioned angularly about the circumference of the bar stock 12 as shown best in FIGURE 5 which transformers are operable in conjunction with the measuring circuit 102 to develop a signal representative of the cross sectional area of the bar stock 12. The electronic means 18 further includes a mechanical full wave rectifier 104 for rectifying the signal developed in the measuring circuit 102, a feed back circuit 106 for stabilizing the signal produced by rectifier 104, and a filter network 108 for filtering the stabilized and rectified signal from the rectifier 104. A servo-amplifier circuit 110, servo-motor 112 and gear drive 114 operable to position the sine bar 70 transversely of the bar stock 12 in accordance with the signal received thereby from the filter network 108 are also provided in control circuit 18.

A portion of the electronic control circuit 18 illustrated in block diagram form in FIGURE 1 is shown in schematic form in FIGURE 6. The operation of the electronic control circuit 18 will become apparent on consideration of the schematic portion of FIGURE 6. With switch 116 closed power is supplied to the primary coil 118 of transformer 120 through use 122, thus applying alternating voltage to the secondary coils 124 and 126 of transformer 120.

Secondary coil 126 of transformer 120, as illustrated in FIGURE 6, supplies voltage to the primary coils 128 through 135 of the individual transformers 136 through 143. The transformers 136 through 143 are provided

with movable core members 144 through 152. Each of the transformers 136 through 143 is provided with a pair of secondary coils 153–154, 155–156, 157–158, 159–160, 161–162, 163–164, 165–166 and 167–168, respectively. One of the secondary coils of each of the transformers 136 through 143 is connected in each of the series of coils 169 and 171 as shown.

The transformers 136 through 143 are linear variable differenital transformers and are such that movement of the core members thereof will equally and oppositely change the magnitude of the voltages in the two secondary windings thereof. The direction of change of magnitude of the voltages will depend on the direction of movement of the core.

Thus with the transformers 136 through 143 arranged angularly about the bar stock 12 as shown in FIGURE 5, movement radially inwardly of the bar stock of one of the transformers 136 through 143 without a corresponding radially outward movement of the opposite transformer will produce a variation in the voltage across resistors 170 and 172 in the measuring circuit 102. Since the secondary coils of the transformers are connected in series 169 and 171 as shown in FIGURE 6, the total change in the signal across resistors 170 and 172 in measuring circuit 102 will be representative of the variation of the cross sectional area of the bar stock at the point of contact therewith by the transformers arranged as shown in FIGURE 5.

Rectifier 104 as illustrated in FIGURE 6 is a mechanical full wave rectifier which is actuated by circuit 174 which includes the secondary coil 124 of transformer 120, capacitor 176 and coil 178. The action of rectifier 104 in conjunction with the series connected transformer secondaries 153 through 168 of the transformers 136 through 143 is to produce an output the polarity and magnitude of which depends on the variation of the cross sectional area of the bar stock from a preselected cross section as will be understood by those familiar with the operation of these devices.

The rectified signal from rectifier 104 is passed through the filter network 108 comprising resistors 180 and 182 and capacitors 184, 186 and 188. The rectified and filtered signal which is representative of the cross sectional area of the bar stock at the point of contact of the bar stock with the transformers is then passed to the servo-amplifier 110 where it is amplified to a value to operate the servo-motor 112 which in turn moves the sine bar 70 through gear drive 114 and actuating means 74 to position the sine bar so that a length of bar stock sufficient to provide a slug of predetermined volume having the diameter sensed is fed to the cutter 14.

Feed back means 106 comprising a stabilizing unit 190 in conjunction with resistors 192 and 194 are provided in the electronic circuit 18 to prevent transient conditions from causing erroneous signals from being fed to the servo-amplifier 110.

Resistors 196 and 198 are provided in series with the secondary coils of the transformers 136 through 143 as shown to limit current therethrough. Slide wire 200 in conjunction with movable arm 202 is also provided in series between the series 169 and series 171 of secondary coils as shown in FIGURE 6, to provide means for setting the zero output position of the rectifier 104 which corresponds to bar stock having a predetermined diameter and a particular setting of sine bar 70.

Slide wire 204 is also provided in series with the secondary coils of the transformer 136 through 143 in conjunction with movable arm 206 to balance the voltage produced by the different secondary coils of the series 169 and 171. Thus the movable arm 206 is driven by gear drive 114 so that it is always positioned to give a zero output from rectifier 104 if the sensed cross sectional area of the bar stock 12 has not changed between cycles of operation of the apparatus 10 and the cutting of a slug from the bar stock 12 by cutter 14.

The actual length of the slug fed to the cutter 14 by means 10 for a given variation from a zero voltage difference developed between coil series 169 and 171 may be set by the length control potentiometer 208 which is in series with resistor 210 and in parallel with the resistor 204 since by varying the resistance of resistor 208 the signal across resistor 170 and 172 which is fed to the rectifier 104 and consequently to servo-amplifier 110 is varied.

The servo-amplifier 112, servo-motor 113 and gear drive 114 shown in FIGURES 1 and 6 are completely conventional and therefore they will not be discussed in detail.

The transformers 136 through 143, as shown best in FIGURE 5, are supported in circular yoke 212. The cores of the transformers are each mounted on a separate rod 216 having a wear-tip 218 on one end thereof and having a piston 220 on the other end thereof reciprocal in a bore 222 in yoke 212. As indicated yoke 212 is provided with a pair of annular hydraulic passages 224 and 226 communicating with each of the bores 222 to effect reciprocal movement of the pistons 220, the cores and rods 216 on reversing of the hydraulic pressures within the passages 224 and 226. The coils of the transformers are positioned adjacent the core thereof as shown in FIGURE 5 so that movemment of the core changes the coupling of the primary and secondary coils of the transformers to produce the voltage differential between the secondary coils of the transformer previously indicated.

In operation hydraulic fluid is exhausted from chamber 226 and placed in chamber 224 under pressure to cause the wear-tip 218 of the transformers to engage the surface of the bar stock 12 and to remain in engagement therewith as the bar stock is fed into the cutter 14. Means may be provided however, such as coil 228, responsive to the output of the servo-amplifier 112 for actuating conventional switching (not shown) to reversing the hydraulic pressure in chambers 224 and 226 to cause the rod 216 to withdraw the wear-tip 218 from contact with the surface of bar stock 12 on the output of the servo-amplifier being above a predetermined maximum.

Thus when an exceptionally large signal such as that caused by the end of the bar stock passing the transformers is fed to the servo amplifier, the rods 216 are withdrawn by reversal of the pressure in the chambers 224 and 226 to prevent breaking of the rods by subsequent bar stock inserted in the cutter 14. The coil 228 may also be used to open switch 116 to prevent the return of the rods 216 to their radially inner position before subsequent bar stock is fed into the cutter 14.

In the over-all operation of the apparatus described above it will again be assumed that a slug has been cut from the bar stock 12 by cutter 14 and that the bar stock 12 is tightly gripped by gripping means 22 and 24 with the gripping means 22 positioned against the abutment 80. It will also be assumed that the wear-tips 218 associated with transformers 136 through 143 are engaged with bar stock 12 as shown in FIGURE 5. Switch 16 is assumed closed.

In a cycle of operation, as previously indicated gripping means 22 is caused to release the bar stock 12 and to be moved into engagement with the sine bar 70 which has been previously positioned laterally of the bar stock 12 so that on subsequent movement of the gripping means 22 into contact with stop 80 a length of bar stock 12 will be fed into cutter 14 which is related to a previously sensed bar diameter to provide a slug of given volume. Gripping means 22 is then caused to regrip the bar stock 12, the gripping means 24 is caused to release the bar stock 12, and gripping means 22 is moved into position abutting stop 80 whereby the bar stock 12 is fed to cutter 14.

As the bar stock 12 is fed to the cutter 14 the variation in cross sectional area of the bar stock is sensed by the control circuit 18 in the manner just described to produce

an electric signal operable to cause the sine bar 70 to move transversely of the bar stock 12 in a direction to compensate for the difference in cross sectional area of the bar stock 12. The difference in the cross sectional area sensed is compensated for by either allowing a longer or shorter length of bar stock to be fed to cutter 14 during the next cycle of operation so that a slug of given volume will always be cut from the bar stock 12 regardless of the irregular cross sectional area thereof on operation of the cutter 14. The cutter 14 is then caused to cut the slug from the bar stock as previously indicated completing the cycle of operation of the apparatus disclosed.

Thus in accordance with the invention a method of producing slugs of given volume from bar stock having an irregular cross sectional area comprising the steps of sensing the cross sectional area of the bar stock and feeding a length of bar stock into a cutter which is so related to the cross sectional area as to produce a slug of given volume on operation of the cutter.

A modification of the method and apparatus for producing slugs of a predetermined volume from irregular bar stock as set forth above is illustrated in the block diagram of the electronic control circuit 18*a* shown in FIGURE 7. The control circuit 18*a* is similar in every way to the control circuit 18 and in addition includes an amplifier 230 immediately following the filter 108*a* and a delay device 232 which may for example be a storage tape or drum and read-in and read-out means associated therewith. The output from delay 232 is fed to the servo-amplifier 110*a*.

Thus in accordance with the modification a delay is introduced in the positioning of the sine bar 70 of the spacing means 16 so that the sensed cross section of the bar stock 12 which has caused the positioning of the sine bar 70 for a given cycle of operation may be centrally positioned in the slug cut from the bar stock 12 during that cycle of operation. Thus with the modified electronic control circuit 18*a* the sensed cross sectional area will be more nearly the average cross sectional area of the particular slug whose length is determined thereby.

A second modification 18*b* of the electronic control circuit 18 is illustrated in FIGURE 8. In the control circuit 18*b* a series of control circuits such as that shown in FIGURE 8 through the delay means 232 are provided at closely spaced longitudinal intervals along the bar stock 12. Thus a plurality of different cross sectional areas of the bar stock 12 will be sensed by the electronic control circuit 18*b*.

The signals from the delay means 232*b* are passed to individual amplifiers 234 and are then electronically multiplied in multipliers 236 by factors representative of the distance longitudinally of the bar stock 12 of the sum of half the distance between the sensed cross sectional area and each of the adjacent cross sectional areas sensed to provide a signal indicative of small volumes of the bar stock immediately adjacent the cross sectional areas sensed.

The signals from the multipliers are then fed to an electronic adding circuit 238 where the individual signals are combined. On the signal in the adder reaching a predetermined value representative of a slug of predetermined volume the cutter is caused to operate. It will therefore be seen that since the delay means 232*b* is provided in the electronic control circuit 18*b* that the accuracy in volume of the slugs cut from bar stock 12 will be determined only by the possible spacing of the groups of transformers longitudinally of the bar stock 12.

The drawings and the foregoing specification constitute a description of the improved method and apparatus for producing slugs of predetermined volume from irregular bar stock in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. Apparatus for producing slugs having a predetermined volume from bar stock having an irregular cross section comprising, a cutter, bar feeding means located adjacent said cutter for feeding lengths of bar stock into said cutter, a plurality of linear variable differential transformers each including a radially extending rod carrying the transformer core resiliently biased into contact with the bar stock which transformers are located angularly about the bar stock in opposed pairs for sensing the cross sectional area of the bar stock adjacent the length thereof to be fed to the cutter, means for developing an electric signal representative of the cross sectional area sensed, a stop operably associated with said means for feeding lengths of bar stock into said cutter to regulate the length of bar stock fed to the cutter, and means operably associated with the stop for positioning the stop in accordance with the developed electric signal.

2. Structure as claimed in claim 1 wherein said means for developing an electric signal representative of the cross sectional area sensed comprises a measuring circuit, a mechanical rectifier and a filter connected in series to receive the output of said transformers and deliver an output signal to said means for positioning said stop.

3. Structure as claimed in claim 2 wherein said stop comprises a sine bar having a tapered surface positionable transversely of the bar stock operable to abut a similarly tapered surface on said means for feeding the bar stock into said cutter to limit movement thereof in accordance with the adjusted position of the sine bar transversely of the bar stock.

4. Structure as claimed in claim 3 wherein said means for positioning the stop in accordance with the developed signal comprises a servo-amplifier, a servo-motor and drive means in series between said filter and said stop.

5. Apparatus for producing slugs having a predetermined volume from bar stock having an irregular cross section comprising, a cutter, bar feeding means located adjacent said cutter for feeding lengths of bar stock into said cutter, a plurality of separate sensing means operably associated with the bar stock extending radially of the bar stock and spaced substantially equally therearound for sensing the cross sectional area of the bar stock at a plurality of spaced apart points therealong, means connected to the sensing means for developing electric signals representative of the areas sensed, means in circuit with the electric signal developing means for delaying said electric signals until said cross sections are within the portion of the bar stock to be removed therefrom to form a slug, means in circuit with the means for delaying the electric signals for individually electrically mulitplying the electric signals by a factor representative of the sum of one-half the distance between the cross sectional area sensed and each of the adjacent sensed cross sectional areas to produce a plurality of electric signals representative of adjacent volumes of said bar stock, means in circuit with the multiplying means for adding the signals representative of volume, and means in circuit with the adding means for actuating the cutter when the added signals reach a value representative of said predetermined volume.

6. Apparatus for producing slugs having a predetermined volume from bar stock having an irregular cross section comprising, a cutter, bar feeding means located adjacent said cutter for feeding lengths of bar stock into said cutter, a plurality of separate sensing means extending radially of the bar stock and spaced substantially equally therearound operably associated with the bar stock for sensing the cross sectional area of the bar stock, means for developing an electric signal representative of the area sensed, means for multiplying the electric signal by a factor representative of the length of bar stock fed to the cutter to produce an electric signal representative of the volume of bar stock passing the sensing means and means operably associated with the multiplying means for

actuating the cutter when the value indicated by the multiplying means is representative of a predetermined slug volume.

7. Apparatus for producing slugs having a predetermined volume from bar stock having an irregular cross section comprising, a cutter, bar feeding means located adjacent said cutter for feeding lengths of bar stock into said cutter, a plurality of separate sensing means extending radially of the bar stock and spaced substantially equally therearound for sensing the cross sectional area of the bar stock, means connected to the sensing means for developing an electric signal representative of the area sensed, means in circuit with the electric signal developing means for delaying said electric signal until the cross section the area of which has been sensed is within the portion of the bar stock to be removed therefrom to form a slug, means in circuit with the means for delaying the electric signal for multiplying the electric signal by a factor representative of the length of bar stock fed to the cutter to produce an electric signal representative of the volume of bar stock passing the sensing means and means operably associated with the multiplying means for actuating the cutter when the value indicated by the multiplying means is representative of a predetermined slug volume.

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