July 17, 1956 H. E. MULLER 2,754,964

INSPECTION APPARATUS

Filed July 22, 1952 4 Sheets-Sheet 1

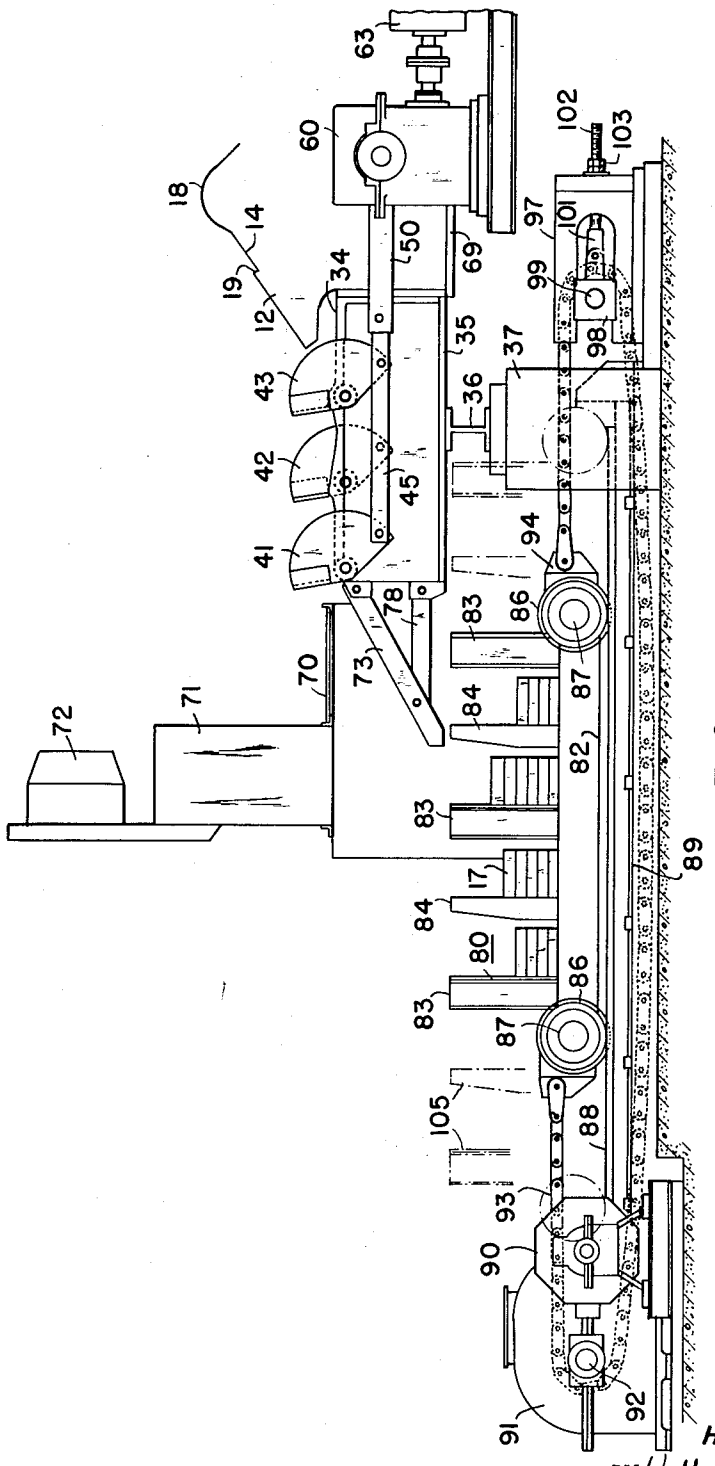


Fig. 1

INVENTOR.
Herman E. Muller
BY Wefft, Mackey & Burden
HIS ATTORNEYS

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INSPECTION APPARATUS

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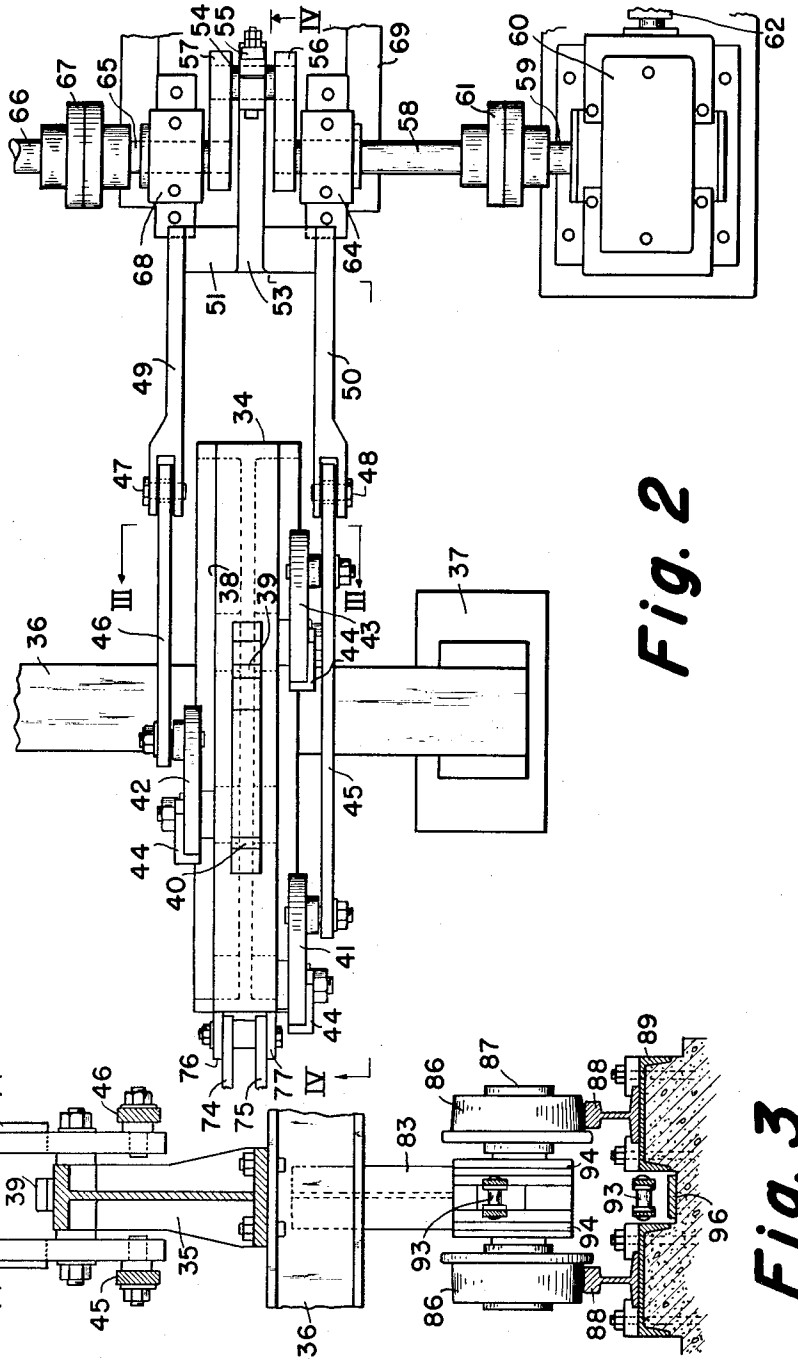


Fig. 2

Fig. 3

INVENTOR.
Herman E. Muller
BY Wefft, Mackey & Burden
HIS ATTORNEYS

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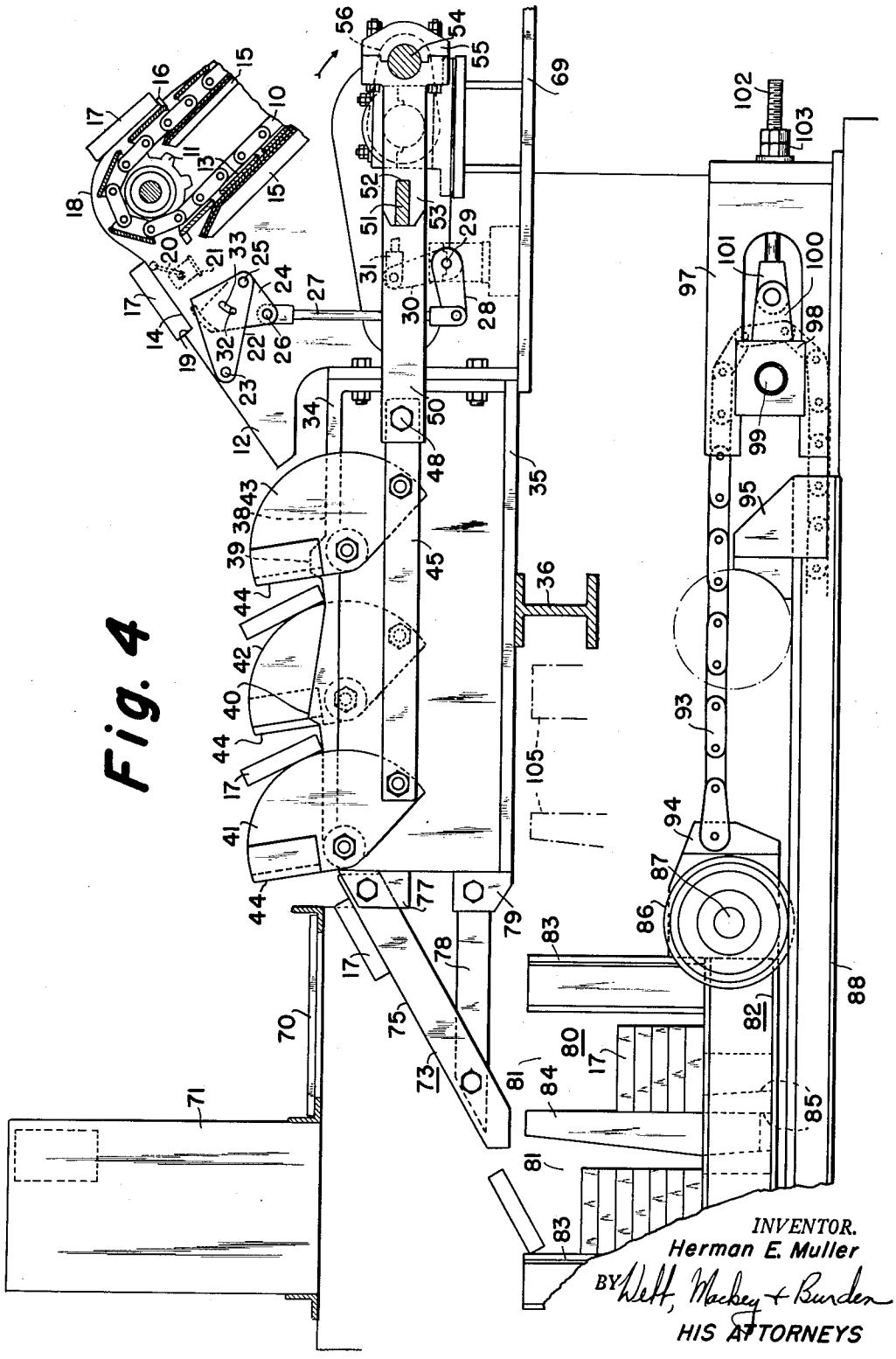


Fig. 4

INVENTOR.
Herman E. Muller
BY Wolff, Mackey + Burden
HIS ATTORNEYS

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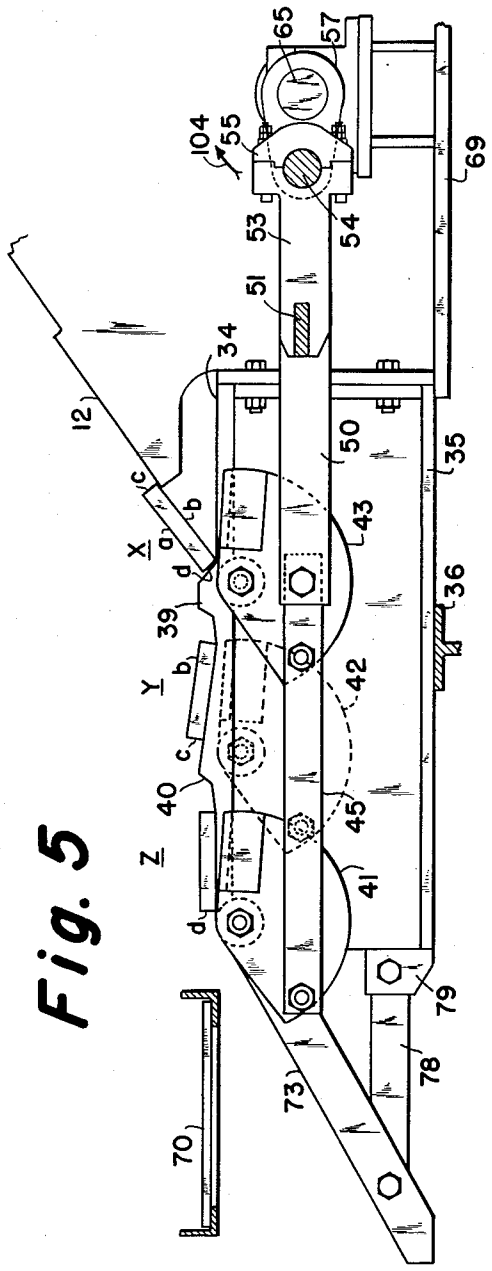


Fig. 5

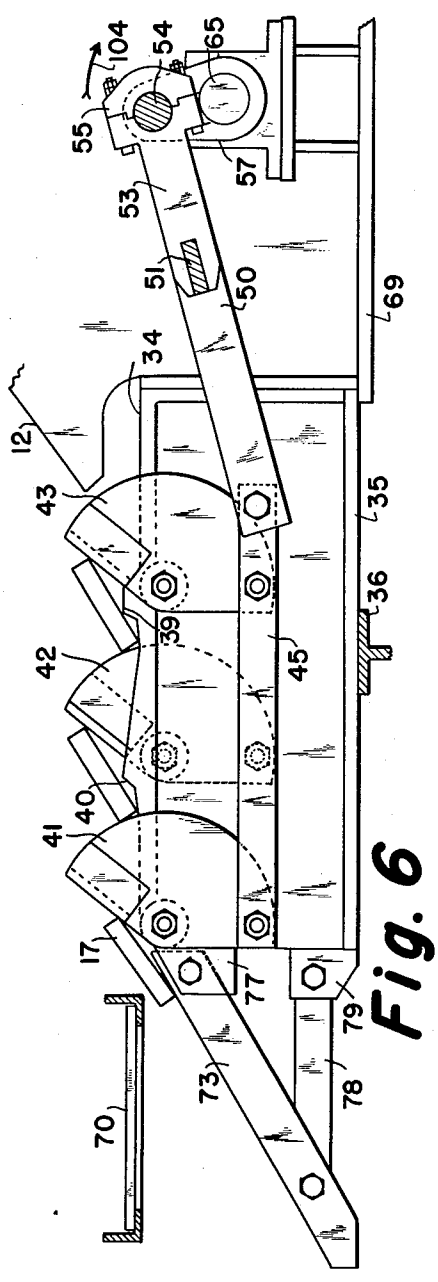


Fig. 6

INVENTOR.
Herman E. Muller
BY Wolff, Mackey & Burden
HIS ATTORNEYS

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2,754,964

INSPECTION APPARATUS

Herman E. Muller, Pittsburgh, Pa., assignor to York Engineering & Construction Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application July 22, 1952, Serial No. 300,263

6 Claims. (Cl. 209—123)

This invention relates to inspection apparatus, particularly apparatus for inspecting long, heavy objects, such as billets, bars, slabs, and the like. The apparatus is intended to receive such articles, automatically provide for examination of all sides, and then sort each object according to any clasification desired.

During the processing of metal billets or slabs it is necessary to inspect all sides for possible defects before approving the slabs for other uses. Prior to the present invention, it was necessary for two operators to grasp the ends of a heavy slab with long wrenches and turn it over on a table to expose each side while another operator inspected the slab. Such a procedure is arduous and time-consuming.

The present invention provides a rapid means of inspection requiring only one operator and resulting in a greatly increased rate of production. In one form, the invention provides an inspection table onto which slabs or billets are advanced one at a time transversely to the table. Lifts mounted on the table engage the billets and turn them over to expose each side and advance the billets along the inspection table.

The present invention also provides novel sorting and receiving apparatus associated with the table. In one form, this apparatus comprises a container having a plurality of compartments which is movable with respect to the discharge end of the inspection table. Automatic controls place a desired compartment in a receiving position adjacent the table.

The accompanying drawings illustrate a presently preferred embodiment of the invention in which:

Figure 1 is a side elevation showing a general arrangement of parts;

Figure 2 is a plan view of an inspection table and eccentric for pivoting the side lifts;

Figure 3 is a section of Figure 2 on the line III—III;

Figure 4 is a section of Figure 2 on the line IV—IV with the auxiliary delivery chute and receiving container also shown for completeness; and

Figures 5 and 6 are side elevations similar to Figure 4 at different stages of the operation of the inspection table.

The embodiment illustrated consists chiefly of three general parts: a feeder for advancing billets, an inspection table for examining the slabs or billets, and a container for receiving the examined billets in different compartments in accordance with their classification.

Referring to these parts in the order stated, and with reference principally to Figures 1 through 4, the feeder may be any standard delivery apparatus such as a conveyor or chain feed, or the billets may be simply laid one by one on the inspection table by a crane or even by hand. However, the preferred practice is to use a feeder of the ejector type such as described in my copending application filed July 22, 1952, Serial No. 300,262. If desired, the operation of the ejector may be synchronized with the operation of the inspecting table as hereafter described.

The feeder of the preferred embodiment comprises, as

shown most clearly by Figure 4, a driven chain **10** which passes over a sprocket **11** journaled for rotation in a support wall **12** and consists of linked flights **13**. Angle bars **15** help support the chain **10** and direct its path of travel. Some of the flights **13** have lugs **16** which push slabs **17** over a hump **18** of the wall **12** onto a rack **14** having a stop **19**. In Figure 4, I have shown the apparatus as handling slabs. Here a slab **17** depresses an arm **20** of a limit switch **21** opening an electrical circuit for the drive for the chain **10**.

The ejecting apparatus is directly beneath the slab retained by the stop **19** and consists of two pairs of spaced-apart, substantially parallel plates of which only one plate of each pair can be seen in the views shown. As more fully described in my copending application above referred to, one pair including plate **22** pivots on the axle **23** journaled in the support wall, while the other pair including plate **24** is inserted between the first pair. All four plates pivot about the axle or pin **25**. Both plates of the inner pair also pivot about an axle **26** joined to a ram **27**. The ram is hinged to a crank arm **28** secured to a shaft **29** which has another arm **30**. When the latter is rotated about this shaft as by a piston **31** of an air actuated cylinder, the ram receives an upward thrust causing the plates to move upwardly and lift the slab **17** over the stop **19**. Thereafter, the slab slides down the wall **12** onto the inspection table. A pin **32** of the plate **24** registers with a slot **33** of the plate **22** to prevent the inner pair of plates from traveling too far about the axle **25**.

The inspection table is in the form of at least two I beams **35**, each tapered at its bottom to provide a wider base. The beams are spaced from each other so as to support a billet or slab adjacent its ends. For long billets more beams may be used. All have the same construction and therefore one only is shown in the drawings. A cross beam **36** resting at its ends on a block **37** partially supports the I beams **35** and accessory parts.

The surface **38** of the table has a plurality of transversely extending mounds designed to receive slabs laid parallel thereto. The first mound is in the form of a ridge **39** on the receiving end of the table against which the entering slabs strike. This ridge prevents the slabs from traveling too far down the table and centers them in a proper position to be engaged by a lift at the side of the table. The second transverse mound is in the form of a ridge **40** having a gradually sloping side in the direction toward the first ridge **39**. The ridge **40** is designed to receive the slab turned over and advanced from ridge **39**. The ridge **40** also centers the slab in its turned condition for proper engagement with another lift.

The lifts which simultaneously turn and advance the slabs down the inspection table comprise sectors **41**, **42**, and **43**. The sectors are parallel to the sides of the table and pivot on the beam **35** at a point adjacent their apices and at points on the table sides below and just before the apices of the ridges **39** and **40** looking from the receiving end of the table. In this way, when the sectors are pivoted, they engage the slabs cleanly as they lie against the ridges.

The sectors are attached as described to both sides of the table, usually in a side-to-side staggered relation. The flat sides of the sectors which contact the slabs may be provided with liners **44** to prevent excess wear.

A bar **45** pivotally connects to sectors **41** and **43** on one side of the table **34**, and a bar **46** similarly joins sector **42** on the other side. The bars in turn are hinged by pins **47** and **48** between the forked ends of connecting rods **49** and **50**. The latter are rigidly linked by a cross strip **51** which is fixed in a slot **52** of a pitman **53** free to turn about a shaft **54**. A strap **55** bolted to the pitman holds it in place. The shaft **54** is part of an eccentric

including crank arms **56** and **57**. Arm **56** is fixed to the main drive shaft **58** which connects to a shaft **59** of a gear reduction box **60** through a coupling **61**. The box may be conventionally driven through the shaft **62** by a motor **63**. A suitable bearing in the bearing housing **64** sustains the shaft **58**. In the same manner, crank **57** is fixed to a shaft **65** joined to another shaft **66** through a coupling **67**. A bearing in the bearing housing **68** supports the shaft **65**, while the platform **69** carries the entire eccentric construction and assists in supporting the inspection table **34**. The shaft **66** may drive another eccentric operating sectors on a beam supporting the other end of the billets or slabs. Adjacent the discharge end of the beams **35** forming an inspection table is an operator's platform **70** where one or more inspectors (depending on length of sections handled), examine the slabs as they turn over on their way to that end of the table. The platform has a cabinet **71** and control box **72** for regulating and control equipment such as push button controls for electrical circuits used to operate various parts of the machine. A delivery chute **73** is also attached to the discharge end of the table and comprises a pair of runners **74** and **75** bolted to lugs **76** and **77**. Girders **78** connect the lower ends of the runners to similar lugs **79** at the bottom of the I beam **35** forming the inspection table.

The chute **73** feeds into a container generally shown at **80** having a plurality of compartments **81** formed by a bottom support frame **82** and vertical transverse sides. Sides **83** are stationary, but the sides **84** disposed therebetween may be moved to various recesses **85**. This allows the container to accommodate billets and slabs of different widths. Wheels **86** on axles **87** support the frame **82** over rails **88** secured to a base **89**.

Forward and backward movement of the container **80** is accomplished by a reversible motor **90** driving a gear reduction box **91** having a drive shaft **92** supporting a sprocket. A link chain **93** passes around this sprocket and an idler sprocket which are disposed at the ends of the rails **88**. The free ends of the chain join lugs **94** at the extremities of the container **80**. Stops **95** at both ends of the rails keep the container on track, while a trough **96** between the rails provides room for the bottom length of the chain. The tension in the chain is adjusted by varying the position of the idler sprocket. A block **97** has side slots provided with rails along which bearing flanges **98** can move. An axle **99**, which turns in the bearing, supports the idler sprocket. Arms **100** free to turn about the axle **99** are placed on either side of the idler sprocket and are further hinged to a corresponding side of a U member **101**. The latter is fixed to a threaded stud **102** passing through a threaded opening in the back of the block **97**. Lock nuts **103** hold the stud in any desired axial position.

In an over-all operation of the embodiment, beginning with the inspection table clear, the operator presses a push button starting the feeder circuit. The chain **10** advances a slab to the stop **19** where the slab depresses the arm **20** opening the limit switch **21**. In this position the switch stops the chain and by conventional electric circuits starts the table motor **63** turning the shaft **65** in the direction of the arrows **104** of Figures 5 and 6. After one revolution of the shaft, a crank arm strikes another limit switch stopping the motor **63**. During this revolution, however, the sectors **41**, **42**, and **43** move to a receiving position as shown in Figure 5, and the delivery apparatus lifts a slab over the stop **19**. For this action an operator can actuate the piston **31** as described in my mentioned copending application or the delivery apparatus may be operated by an eccentric on a shaft turned by the same motor **63**. The slab slides off the support wall **12** and against the ridge **39** to the position X in Figure 5. Of the two faces *a* and *b* and the two sides *c* and *d* of the billet, face *a* is easily inspected at this stage.

The operator now presses the same push button repeating the operation just described. When the sector **43** is

pivoted this time, it pushes the slab from the X position over the ridge **39** onto the curved back of sector **42** which is also pivoted in unison with sector **43**. As the sector **42** descends, the bottom edge of the slab catches against the other side of the ridge **39** forcing the slab to slide over the curved back of sector **42**. The sector **43** rotates more than 90° (i. e., the flat side of the sector which engages the slab moves past the vertical) to insure that the slab falls against the curved back of sector **42**. After this sector is below the surface of the table, the slab falls forwardly to position Y and exposes face *b* and side *c* for inspection.

The operator next presses the same push button starting the feeder circuit, and the entire operation as just described is repeated. This time when sector **42** is pivoted, it lifts the slab over the ridge **40** onto the curved back of sector **41**. As before when this sector descends, the slab catches against the down-table side of ridge **40** and slides along the back of sector **41**. When this sector is below the table, the slab drops to position Z where side *d* is inspected.

The operator now decides into what compartment of the container **80** the billet in position Z should go and by conventional electric controls operates the described machinery to register the selected compartment with the chute. Dotted lines **105** in Figures 1 and 4 show some of the positions the sides **83** and **84** may take when the container moves.

Although the positioning of the container, the feeding apparatus, and the inspection apparatus may all be independently controlled, it is also possible by the use of standard electric controls to have at least some of these operations initiated by the ending of a preceding one. Also, it is possible to join the eccentric drive shaft **66** and the link chain drive shaft **92** to other shafts aligned therewith through synchronizing jaw clutches. This construction permits an inspection unit to be operated independently when relatively short billets are processed, or two or more inspection tables may be joined by the clutches into one single larger inspection unit when long billets are processed.

While the foregoing disclosure describes a presently preferred embodiment, it is understood that the invention may be practiced in other forms within the scope of the following claims.

I claim:

1. Inspection means for elongated members comprising in combination a table having an irregular surface contour shaped to receive the elongated members transversely thereof, a feeder for so depositing such members one at a time onto the table, sector members pivotally joined to the sides of the table in substantially a staggered relation, bars pivotally secured to the sector members on a given side of the table to pivot them in unison, and a reciprocating rod for imparting an axial motion to the bars whereby in an upward pivot, a flat edge of a sector member engages an elongated member to advance it against the arcuate edge of an adjacent sector member, and whereby in a downward pivot, said arcute edge guides the advanced elongated member into a new position on the table, a container for receiving the elongated members from the table consisting of a plurality of compartments, and locomotive means for registering a desired compartment in a receiving position.

2. Inspection means for slabs and like articles comprising in combination a table having an irregular surface contour in a longitudinal direction which is shaped to receive slabs transversely thereof as they progress from one end of the table to the other, a feeder for advancing slabs singly onto the receiving end of the table, sectors pivotally joined to the sides of the table in substantially a side-to-side staggered relation at a point on the sectors adjacent their apices, a bar positioned on each side of the table and pivotally secured to the sectors on that side, eccentric means to impart reciprocal movement to the

bars simultaneously substantially in an axial direction whereby in an upward pivot of two adjacent sectors, a flat edge of one engages an article lying on the table and simultaneously turns and advances the article against the arcuate edge of the adjacent sector, and whereby in a downward pivot of the sectors, said arcuate edge slidingly engages said advanced article to complete the turning thereof and deposit the article in a new inspection position on the table, a container having a plurality of compartments positioned by a discharge end of the table and adaptable to move with respect thereto, and locomotive means for moving the container and registering a desired compartment in a receiving position.

3. Inspection means for slabs, billets, and like articles, comprising in combination a table having a plurality of transverse mounds to receive slabs laid parallelly thereto as the slabs progress from one end of the table to the other, a feeder for advancing slabs singly onto a receiving end of the table, sectors pivotally joined to sides of the table in substantially a side-to-side staggered relation at a point on the sectors adjacent their apices, a bar positioned on each side of the table and pivotally secured to the sectors on that side of the table at a point on the sectors substantially at the lower end of the arc, eccentric means to impart reciprocal movement to the bars simultaneously in an axial direction whereby in an upward pivot of two adjacent sectors, a flat edge of one sector engages an article lying on the table and simultaneously turns and advances it over a mound and against an arcuate edge of the other sector, and whereby in a downward pivot of the sectors, said arcute edge slidingly engages said advanced article to complete the turning thereof and deposit it in a new inspection position on the table, a container having a plurality of compartments positioned by a discharge end of the table and adaptable to move with respect thereto on guide rails, and locomotive means to move the container on the rails and register a desired compartment in a receiving position.

4. Apparatus for inspecting all sides of a slab, billet, or like article, comprising in combination a table having a surface provided with a transverse ridge on a receiving end and a second transverse ridge toward the discharge end; a feeder for placing slabs one at a time transversely to the table and against the ridge; sectors pivotally joined to the sides of the table in substantially a side-to-side staggered relation; said joining being effected at a point on the sectors adjacent their apices, and on the sides of the table at least at points below and just before the apices of the ridges looking from a receiving end of the table; a bar positioned on each side of the table and pivotally secured to the sectors on that side of the table at a point on the sectors substantially at the lower end of the arc; an eccentric to impart reciprocal movement to the bars simultaneously in an axial direction whereby in an upward pivot of two consecutive sectors, a flat edge of the sector nearer the receiving end engages a slab lying on the table and simultaneously turns and advances the slab over a ridge and against the arcuate edge of the other sector, and whereby in a downward pivot of the sectors, said arcuate edge urges the advanced slab against the downtable side of the ridge by slidingly engaging the slab thereby completing the turning thereof and depositing the slab in a new inspection position on the table; a delivery chute at the discharge end of the table; a container having a plurality of compartments adaptable to move with respect to the chute on guide rails; and locomotive means to move the container on the rails and register a desired compartment with the delivery chute.

5. An inspection table for slabs, bars, billets and the like, comprising a surface for supporting the article to be inspected and across which the article is moved during the inspection, at least two sectors mounted adjacent said surface for rotation about points adjacent their respective apices, each of said sectors being rotated so that a flat side of the sector moves from below the articles on said surface to raise an article to be inspected and positioned above it on said surface and turns the article about it longitudinal axis, ridges in said surface extending generally parallel to the longitudinal axis of the article to be inspected as it moves across said surface, said ridges being positioned adjacent the pivot points of the sectors and adapted to engage the edges of said article and assist the sectors in turning said article about its longitudinal axis, and means for rotating the sectors simultaneously whereby during rotation the flat sides of adjacent sectors form substantially the same angle with said supporting surface.

6. An inspection table for slabs, bars, billets, and the like comprising a surface for supporting the article to be inspected and across which the article is moved during the inspection, at least two sectors mounted adjacent said surface for rotation about points adjacent their respective apices, each of said sectors being mounted with their curved surfaces facing towards the end of the table on which the articles ars first placed and being rotated so that a flat side of the sector moves from a position below an article on said surface to raise the article from said surface and turn the article about its longitudinal axis, said sectors being so positioned from each other along the surface that an article moved by one of the sectors engages the next sector in the line of movement of the article across the table, and means for rotating the sectors simultaneously and more than 90° from a position below the article whereby the article raised and turned by a sector falls against the curved side of the next sector.

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