Aug. 13, 1968 L. C. MILLER 3,396,565

APPARATUS FOR BENDING METAL TUBING

Filed Sept. 30, 1965 2 Sheets-Sheet 1

FIG. 1.

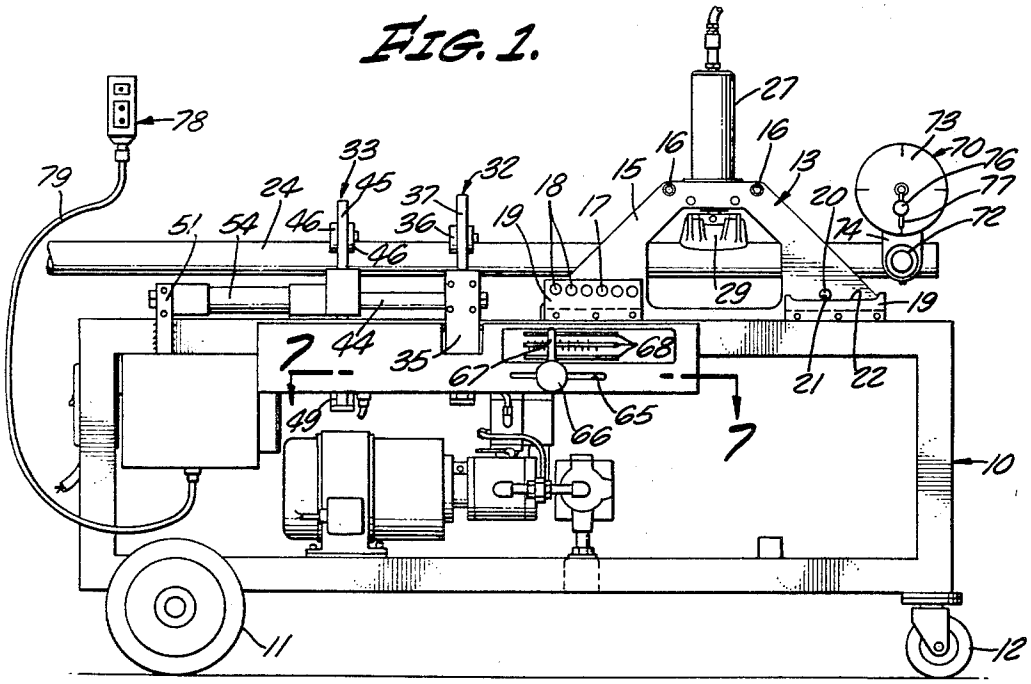


FIG. 2.

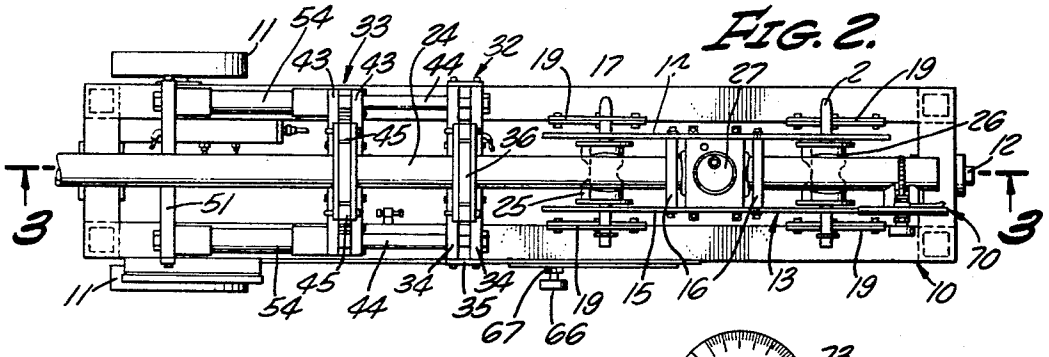
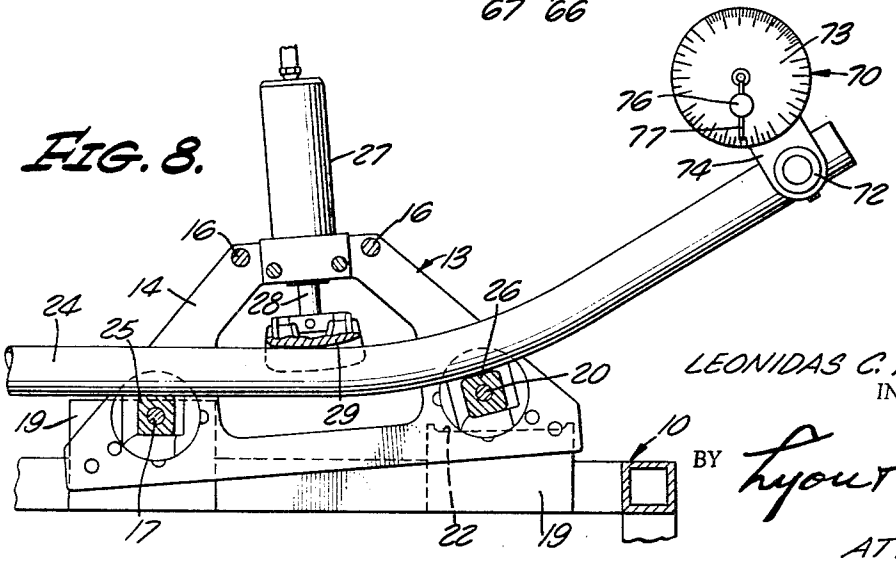


FIG. 8.



LEONIDAS C. MILLER
INVENTOR.

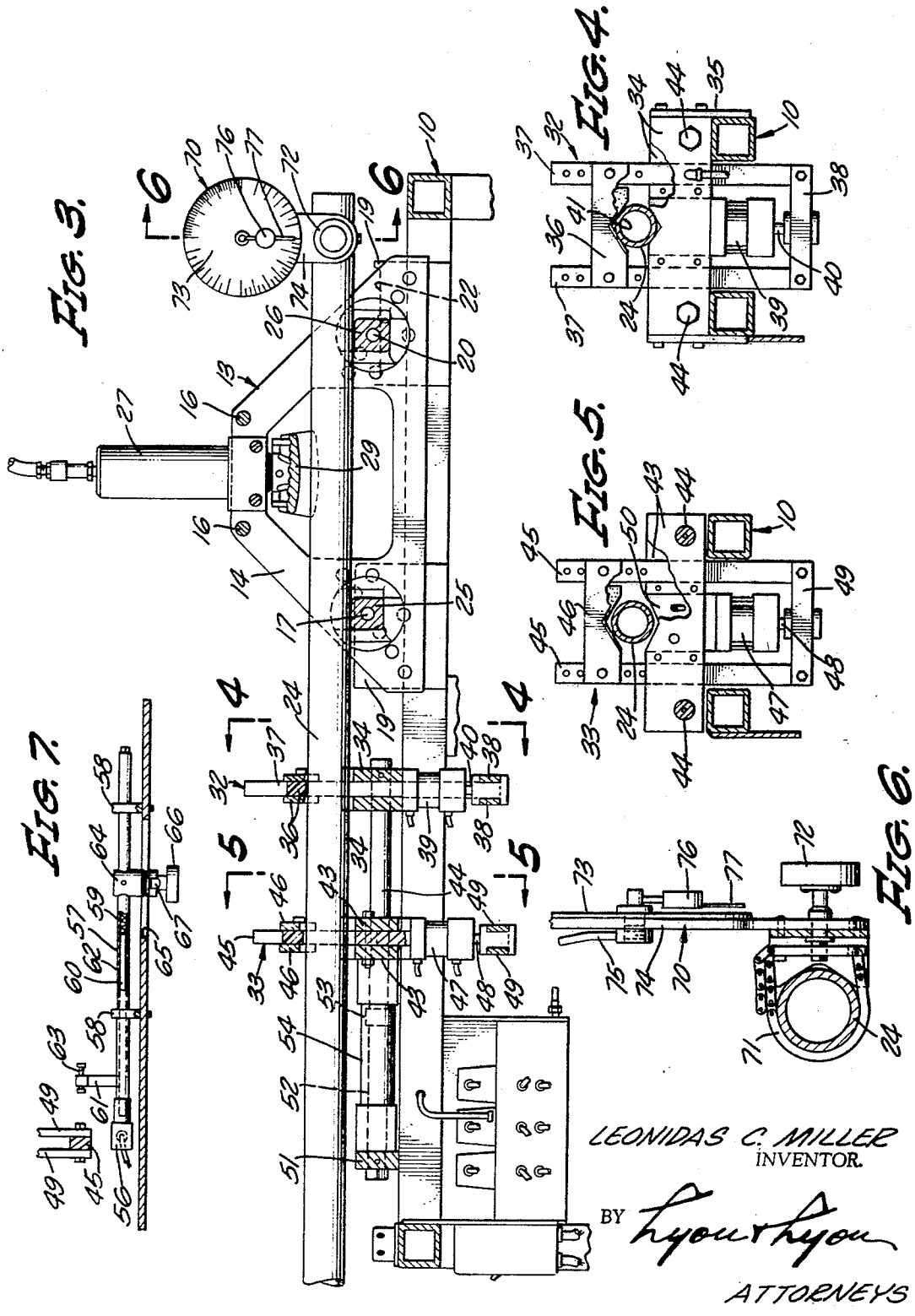
BY Lyon & Lyon

ATTORNEYS

Aug. 13, 1968 L. C. MILLER 3,396,565

APPARATUS FOR BENDING METAL TUBING

Filed Sept. 30, 1965 2 Sheets-Sheet 2



LEONIDAS C. MILLER
INVENTOR.

BY Lyon & Lyon

ATTORNEYS

United States Patent Office 3,396,565
Patented Aug. 13, 1968

3,396,565

APPARATUS FOR BENDING METAL TUBING

Leonidas C. Miller, % L. C. Miller Co., 717 Monterey Pass Road, Monterey Park, Calif. 91754

Filed Sept. 30, 1965, Ser. No. 491,621
3 Claims. (Cl. 72—216)

ABSTRACT OF THE DISCLOSURE

Clamp mechanism for intermittently advancing a tubing axially through a bending frame assembly includes a first clamp device fixed on a stationary frame and a second clamp device reciprocable on the frame, the second clamp device having jaws which float vertically for self-positioning with respect to the tubing.

This invention relates to metal forming apparatus and is particularly directed to a machine for bending metal tubing or pipe and particularly electrical conduit.

This invention relates to improvements over the apparatus disclosed in the Bright Patent 3,075,568 granted Jan. 29, 1963. In that patent there is disclosed apparatus for advancing conduit by intermittent motion through a conventional three-point bending frame assembly. The conduit advancing device comprises a single clamp which engages the conduit and which is advanced longitudinally along the base. The conduit is not released from the clamp until all of the bending has been accomplished. This construction requires a very long base and is primarily useful only for producing completed bends having substantially constant radius.

It is an important object of the present invention to provide bending apparatus of the general type shown in the Bright patent but having a novel form of feeding mechanism for moving the conduit intermittently through the bending device, so that the overall length of the machine may be greatly shortened and so that bends having variable radius (for example, an involue curve) may be produced.

Another object is to provide a device which may be operated with considerable precision by relatively unskilled personnel.

Briefly stated, these and other objects of the invention are achieved by employing a pair of novel clamping devices for engaging the conduit; one is fixed against longitudinal movement on the base and the other is mounted to reciprocate under power with a relatively short stroke longitudinally on the base. Means are provided for alternately closing and opening the stationary clamp and the moving clamp so that the conduit is advanced toward the bending frame assembly in step-by-step increments. Also, adjustable means are provided for varying the stroke of the moving clamp device.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings, FIGURE 1 is a side elevation of a machine comprising a preferred embodiment of this invention.

FIGURE 2 is a plan view thereof.

FIGURE 3 is a sectional elevation taken substantially on the lines 3—3 as shown on FIGURE 2.

FIGURES 4 and 5 are transverse sectional elevations taken substantially on the lines 4—4 and 5—5, respectively, as shown on FIGURE 3.

FIGURE 6 is a sectional detail taken substantially on the lines 6—6 as shown on FIGURE 3.

FIGURE 7 is a sectional detail taken substantially on the lines 7—7 as shown on FIGURE 1.

FIGURE 8 shows a portion of FIGURE 3 and illustrates the action of the bending frame assembly and the clinometer.

Referring to the drawings, the frame or base generally designated 10 may be supported on wheels 11 and 12 for mobility. A conventional three-point bending frame assembly 13 is pivotally mounted on the upper portion of the base 10 near one end thereof. This bending frame assembly comprises a pair of longitudinally extending, laterally spaced parallel side plates 14 and 15. The plates are maintained in alignment by cross bars 16. A horizontal pivot pin 17 projects laterally through aligned aperutres 18 on the parallel plates 19 and the pivot pin also extends through aligned apertures provided on the side plates 14 and 15. Several aligned sets of apertures are provided on the bending frame side plates and also on the plates 19 which are fixed to the base 10, for use in bending conduit of different sizes.

A second pin 20 parallel to pivot pin 17 extends through aligned apertures 21 provided on the bending frame side plates 14 and 15, and the projecting ends of this horizontal pin 20 rest on horizontal support surfaces 22 provided on the stationary plates 19.

A metal tube or conduit 24 extensd longitudinally through the bending frame assembly 13 between the side plates 14 and 15. This conduit 24 rests on contact blocks 25 and 26 which are piovtally mounted on the pins 17 and 20 between the side plates 14 and 15. These blocks 25 and 26 have curved surfaces which conform to the curvature of the outer surface of the conduit 24. A power cylinder assembly 27, hydraulically operated, is fixed to the side plates 14 and 15 in a central position and has a downward projecting piston rod 28 carrying a bending shoe 29 on its lower end. This shoe 29 has a curved surface shaped for contact with the conduit 24. When hydraulic fluid under pressure is admitted into the assembly 27, the piston rod 28 is extended and the shoe 29 applies lateral pressure to the conduit 24 in a location midway between the contact blocks 25 and 26. This produces a bend in the pipe.

In accordance with this invention, novel means are provided for advancing the conduit 24 in step-by-step relation through the bending frame assembly 13. A first clamp device generally designated 32 is mounted on the frame 10 and held against longitudinal movement. A second clamp device generally designated 33 is mounted for longitudinal reciprocation with respect to the frame 10. The first clamp device 32 has a pair of spaced lower jaws 34 attached to straps 35 fixed to the frame 10. A vertically movable upper jaw 36 is fixed at any one of a series of positions on parallel vertical bars 37 joined at their lower ends by a cross bar 38. A hydraulic cylinder assembly 39 is fixed with respect to the lower jaws 34 and has a projecting piston rod 40 connected to the cross bar 38, so that the cross bar and consequently the upper jaw 36 may be raised and lowered under power. The jaws 36 and 34 are provided with V-shaped grooves 41 for gripping the conduit 24 therebetween. The vertical bars 37 slide between the stationary jaws 34.

The clamp device 33 includes a pair of cross heads 43 which slide on parallel longitudinal slide bars 44 fixed to the stationary jaws 34. Parallel vertical bars 45 carrying upper jaw 46 are moved vertically by means of the power cylinder assembly 47, piston rod 48 and cross bar 49. The lower jaw 50 is mounted to slide vertically within the cross heads 43 and the jaws 46 and 50 have V-grooves for contact with the outer surface of the conduit 24. The jaws 46 and 50 are "floating" in the sense that their final position when clamped is determined by the height of the conduit 24 which they clamp between them. This is to be distinguished from the construction of the clamp device 32 wherein the lower jaws 34 are fixed relative to the frame 10 and hence no "floating" action is provided.

A stationary transverse bar **51** fixed to the base **10** is connected to horizontal piston rods **52**. These piston rods **52** are connected to pistons **53** within parallel power cylinder assemblies **54**. The outer cylinder of each assembly is connected to the cross heads **43**. These parallel power cylinder assemblies **54** serve to reciprocate the clamp device **33** along the parallel slide bars **44**, by admitting and exhausting hydraulic fluid from opposite ends of the cylinders.

Suitable pumps, conduits and valves are provided for carrying hydraulic fluid to and from the opposite ends of power cylinders **39**, **47** and **54**. The power cylinder **27** on the bending frame assembly **13** has a single hydraulic connection **30** for delivering hydraulic fluid to depress the piston rod **28** and shoe **29**; the return motion is accomplished by an internal spring, not shown.

Means are provided for limiting the stroke of longitudinal travel of the clamp device **33** along the stationary slide bars **44**. As shown in the drawings, and particularly FIGURE 7 thereof, a microswitch **56** is mounted on one end of a horizontal tube which extends longitudinally of the base **10**. This tube slides through stationary guides **58**. A coil compression spring **59** within the tube **57** acts on one end of a slide rod **60** mounted within the tube. A laterally projecting arm **61** fixed on the rod **60** extends through a slot **62** in the tube and carries an adjustable stop **63** on its extending end. This stop is located for contact by a moving portion of the cross bar **49** of the clamp device **33**. A fitting **64** secured on the tube **62** projects laterally through a longitudinal slot **65** provided on a panel of the base **10**. A friction clamping handwheel **66** is connected to the fitting **64** and acts to clamp the fitting and the tube **62** in longitudinally adjusted position with respect to the base **10**. A vertical index rod **67** travels longitudinally with the tube **62** and fitting **64** and cooperates with several stationary reference scales **68** mounted on the panel of the base **10**. From this description it will be understood that when the tube **62** is clamped near the right-hand end of the slot **65**, maximum travel of the clamp device **33** is permitted before the contact element **63** is engaged to move the rod **60** against the spring **59** and thus actuate the microswitch **56**. This microswitch **56** is electrically connected to solenoid valves which control the entrance and egress of hydraulic fluid to the power cylinder assemblies **54**.

A clinometer device, generally designated **70**, is frictionally attached to the conduit **24** by means of the releasable clamp chain **71** and rotary knob **72**. A circular dial **73** is mounted to turn on the support plate **74** and is clamped in adjusted position by means of the clamping lever **75**. A free-swinging pendulum **76** supported from the axis of the dial **73** carries a pointer **77**. When the clinometer **70** is attached to the conduit **74**, as shown in the drawings, any bending of the pipe is reflected by a change in relative position of the pointer **77** with respect to the dial **73**. Each quadrant of the dial is preferably calibrated in different size angular increments. In ordinary use, only one quadrant is used at a time.

In operation, the conduit **24** is moved axially through the clamp devices **33** and **32** and over the blocks **25** and **26**. The clinometer **70** is clamped to its extending end. The upper jaws **46** and **36** of the clamp devices are adjusted for the proper height. The blocks **25** and **26** and the bending shoe **29** are chosen for proper contact with the conduit, and the pins **17** and **20** are placed at the proper height for cooperation with the blocks. The extending end of the conduit **24** is positioned at the proper location with respect to the centerline of the bending shoe **29**, depending upon the particular bend to be made. The stationary clamp device **32** is then hydraulically actuated to hold the conduit stationary with respect to the frame or base **10**. The power cylinder assembly **27** is then hydraulically energized to depress the shoe **29** to put the initial bend in the conduit **24**. Hydraulic pressure is maintained on the shoe **29** until the pointer **77** on the clinometer **70** moves relative to the dial **73** to the desired angular extent. It will be observed that this bending action causes the extending end of the conduit **24** to lift upward with respect to the base **10**, the pin **20** lifting free of the support surfaces **22**.

The handwheel **66** is then moved longitudinally with respect to the frame slot **65** to the proper position, as indicated by the reference scale **68**, to place the stop **63** at exactly the desired spacing from the cross bar **49** on the longitudinally movable clamp device **33**. This clamp device **33** is then hydraulically actuated to grip the conduit **24** between the jaws **46** and **50**. The clamp device **32** is then released. The clamp device **33** is then moved axially toward the bending frame assembly **13** by means of the parallel power cylinder assemblies **54**. The forward motion of the clamp device **33** and conduit **24** is interrupted when the moving part **49** engages the adjustable stop **63**, thereby operating the microswitch **56**. This microswitch acts through solenoid valves to hold the cylinders stationary with respect to the stationary pistons **53**. The clamp device **32** is then closed and the conduit **24** is in position to receive another incremental bend from the shoe **29**. The moving clamp device **33** is open and then returned axially to its initial position. The cycle is repeated until the desired number of incremental bends has been applied at proper spacing to the conduit **24**.

The remote control device **78** carried on a flexible cable **79** is provided to enable the operator to open and close the clamp devices **32** and **33**, to apply pressure to the bending shoe **29**, and to reciprocate the movable clamp device **33**. Manually operated switches on this remote control device **78**, held in the hands of the operator, enable the operator to fix his attention on the clinometer pointer **76** so that he may de-energize the bending cylinder **27** at the instant that the pointer shows that the proper degree of incremental bend has been applied, allowing for springback. By suitable actuation of the control buttons on the remote control device **78** the operator is enabled to advance the conduit **24** through the bending frame assembly **13** in step-by-step fashion, with the proper degree of bend applied at each step. Suitable electrically operated sequence of valves may be employed so that the movable clamp device **33** returns to its initial position during downward motion of the bending shoe **29**, and while the stationary clamp device **32** is in gripping position, thereby reducing overall sequencing time.

Having fully described my invention, it is to be understood that I am not to be limited to the details herein set forth but that my invention is of the full scope of the appended claims.

I claim:

1. In a machine for bending a conduit, the combination of: a base, bending apparatus mounted on the base, means on the base for feeding the conduit by intermittent motion longitudinally toward said bending apparatus, said means including a pair of releasable clamp devices each having jaws shaped to grip the conduit, means securing a first of the clamp devices against longitudinal movement on the base, the second clamp device including upper and lower clamping jaws each mounted to float relative to said base, means including a hydraulic power cylinder assembly for reciprocating the second clamp device longitudinally on the base, and adjustable means for varying the stroke of said second clamp device, whereby a portion of the conduit may be fed longitudinally through said clamp devices and through said bending frame assembly.

2. In a machine for bending a conduit, the combination of: a base, a bending frame assembly pivotally connected to the base, said assembly having means for contacting the conduit to form an incremental bend, means on the base for feeding the conduit by intermittent motion longitudinally toward said bending frame assembly, said means including a pair of releasable clamp devices each having jaws shaped to grip the conduit, means securing a first of the clamp devices against longitudinal movement on

the base, the second clamp device including upper and lower clamping jaws each mounted to float relative to said base, means including a hydraulic power cylinder assembly for reciprocating the second clamp device longitudinally on the base, and adjustable means for varying the stroke of said second clamp device, whereby a portion of the conduit may be fed longitudinally through said clamp devices and through said bending frame assembly.

3. In a machine for bending a conduit to produce a bent section of desired length and curvature, the combination of: a base, bending apparatus pivotally attached to the base and adapted to receive the conduit, means on the base for feeding the conduit by intermittent motion longitudinally toward said bending apparatus, said means including a pair of releasable clamp devices, each having relatively movable jaws shaped to grip the conduit, one jaw of one of said clamp devices being fixed to said base,

the jaws of the other clamp device each being movable to float laterally with respect to the base, power-operated means for reciprocating the latter said clamp device longitudinally on the base, and adjustable means for varying the stroke of the latter said clamp device, whereby at least a portion of the conduit may be fed longitudinally through said clamp devices and through said bending frame assembly.

References Cited

UNITED STATES PATENTS

3,147,792	9/1964	Hautau	72—150
3,299,681	1/1967	Hautau	72—150

CHARLES W. LANHAM, *Primary Examiner.*

R. D. GREFE, *Assistant Examiner.*