Dec. 16, 1947. S. FINDLATER 2,432,566

TAPERING METAL TUBES

Filed Sept. 8, 1944 3 Sheets-Sheet 1

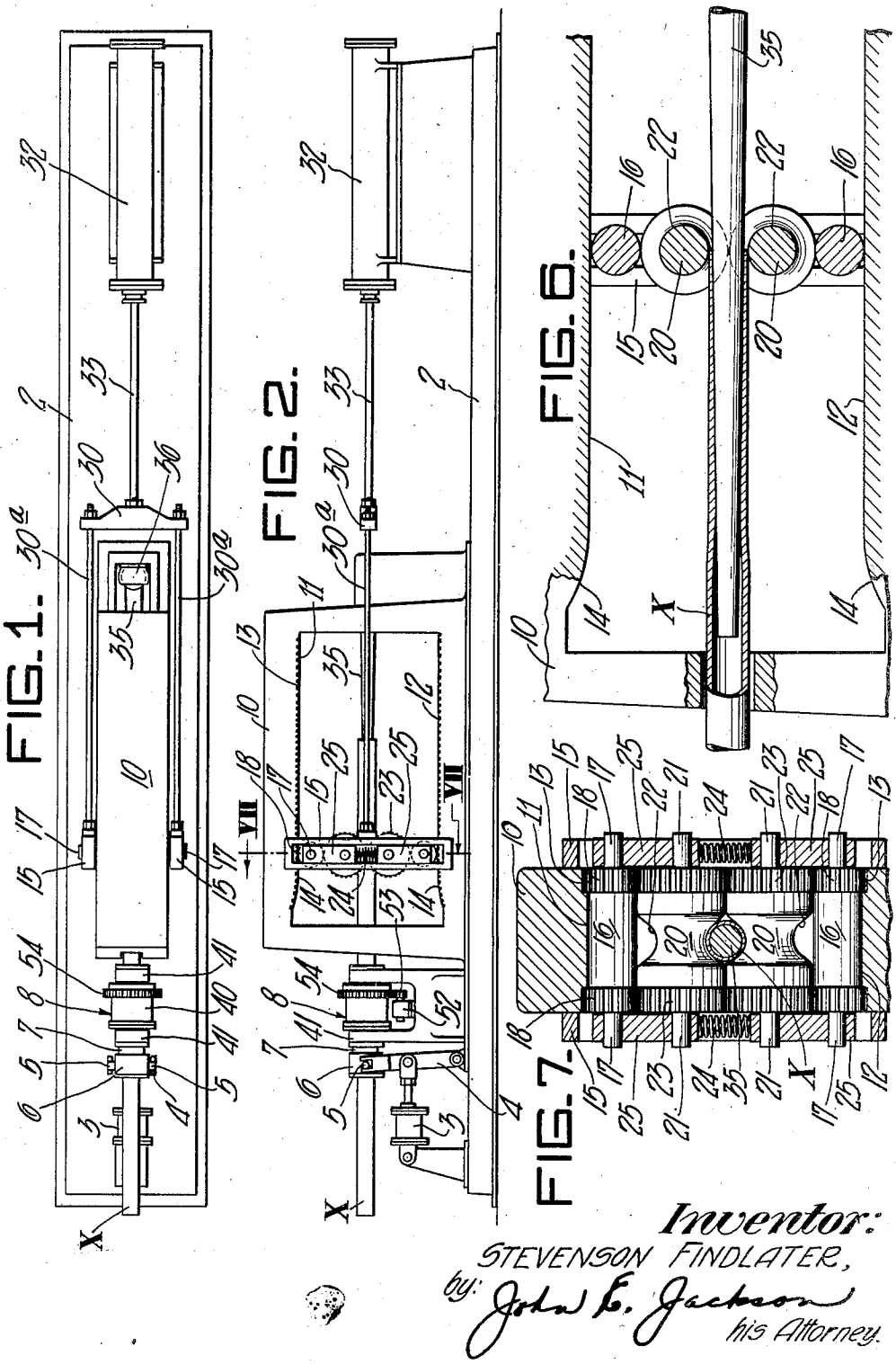

FIG. 1.

FIG. 2.

FIG. 6.

FIG. 7.

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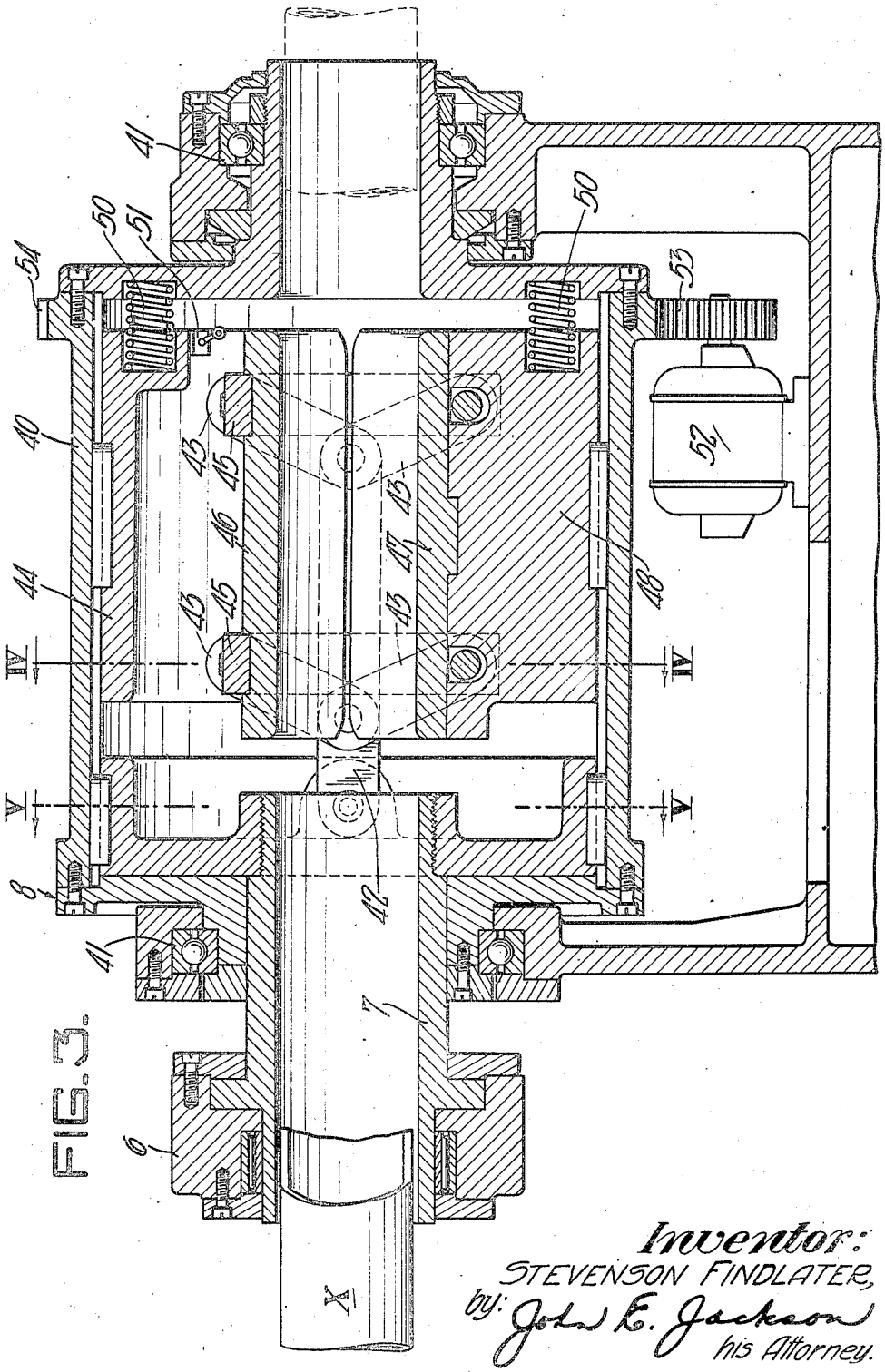

FIG. 3.

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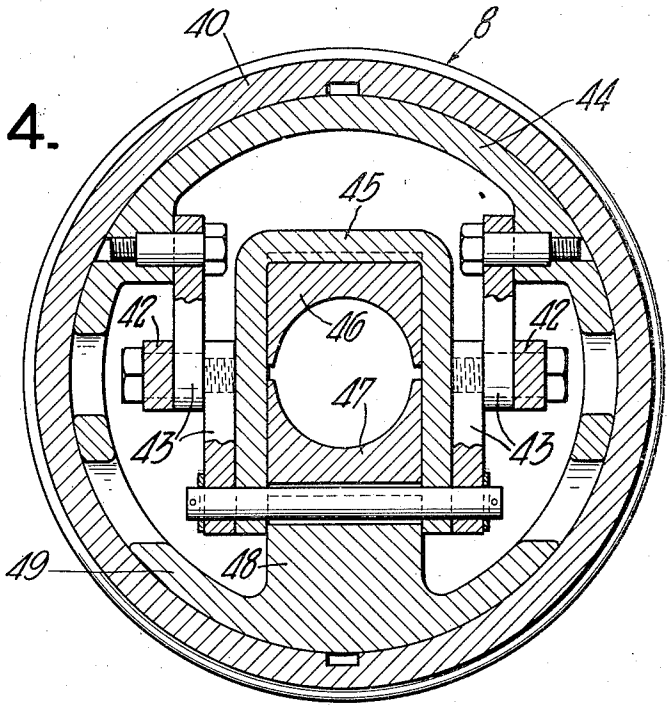
FIG. 4.



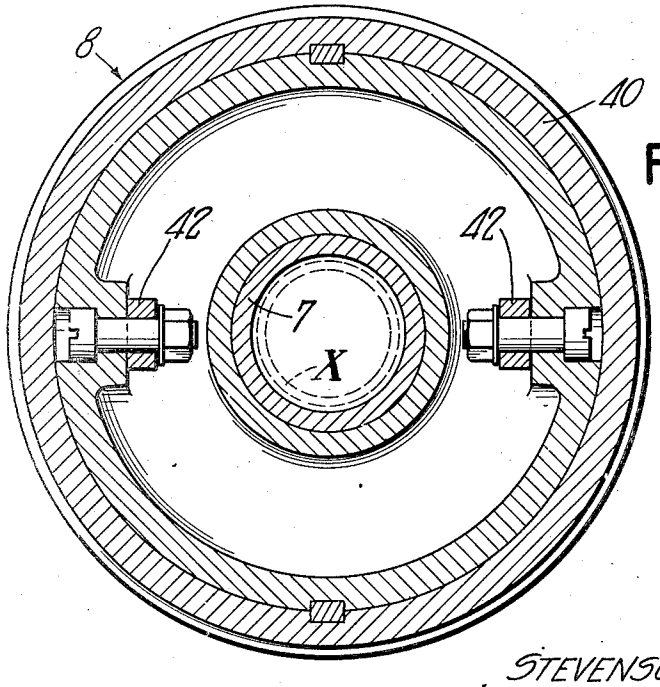


FIG. 5.

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UNITED STATES PATENT OFFICE

2,432,566

TAPERING METAL TUBES

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Application September 8, 1944, Serial No. 553,214

3 Claims. (Cl. 80—12)

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This invention relates to a method of and apparatus for tapering metal tubes and, more particularly, to a method of and apparatus for forming metal tubes having a uniform outside diameter and a tapered inside diameter.

There frequently arises a need for tubes having a substantially uniform outside diameter but in which the walls taper in accordance with requirements of the use for which they are intended. Such an example may be found in the tubes employed for producing airplane propeller blades. A heavy wall in the base of such tubes is needed to provide sufficient strength to accommodate the centripetal forces while a lighter wall near the tip of the blade reduces the overall centrifugal force but supplies sufficient strength to meet the torsional requirements.

It is accordingly an object of the present invention to provide a method of forming metal tubes having a uniform outside diameter and a tapered inside diameter.

It is another object to provide an apparatus for forming metal tubes having a uniform outside diameter and a tapered inside diameter.

It is a further object to taper tubes uniformly in an expeditious manner.

The foregoing and further objects will be apparent from the specification and drawings wherein:

Figure 1 is a plan view of an embodiment of my invention;

Figure 2 is a side elevational view thereof;

Figure 3 is a longitudinal cross-sectional view of the tube gripping and turning mechanism shown at the left hand end of Figures 1 and 2;

Figures 4 and 5 are cross sections along lines IV—IV and V—V of Figure 3;

Figure 6 is a side elevation, partly in section, of the tube forming apparatus, showing a tube therein; and

Figure 7 is a cross section along lines VII—VII of Figure 2.

Referring more particularly to the drawings, the numeral 2 designates a base on which is pivotally mounted a fluid pressure cylinder 3 connected to lever 4 which is pivotally connected at its lower end to the base 2, and at its upper end engages trunnions 5 on collar member 6 carried by rotatable spindle 7 of a clamping and rotating device 8. The member 8 clamps a workpiece extending therethrough, moves it forwardly and rotates it a partial revolution upon actuation of the fluid pressure cylinder 3. The construction and operation of the clamping and rotating device 8 will be more fully described hereinafter.

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A fixed housing 10 is also carried by the base 2 and has a pair of spaced parallel surfaces 11 and 12 of the desired width, each of which carries a pair of racks 13. Surfaces 11 and 12 have a diverging portion 14 at the entry side thereof adjacent the clutch member 7.

Disposed in the fixed housing 10 is a roll housing 15 which carries a pair of backing up rolls 16 in engagement with the surfaces 11 and 12, the rolls 16 having gears 18 keyed or otherwise secured to necks 17 thereof, which gears are in mesh with the racks 13. Interiorly disposed in the roll housing 15 between the backing up rolls 16 is a pair of working rolls 20 having substantially semi-circular grooves 22 therein of constant diameter forming a substantially circular pass therebetween. Gears 23 which are keyed or otherwise secured to necks 21 of the working rolls 20 are in engagement to key the rolls 20 together and also engage the gears 18. Necks 17 and 21 are journaled in bearing blocks 25, slidably mounted in roll housing 15, and are biased outwardly by spring 24 to keep the gears 18 in mesh with racks 12 and 13 and also to open the pass when the roll housing is positioned between the diverging surfaces 14.

The ends of a yoke 30 are connected to roll housing 15 by rods 30a on either side of the housing 10, and the center portion is connected to a piston rod 33 operated by an hydraulic cylinder 32 mounted on the base 2. Thus, it is seen that admission of fluid under pressure to alternate ends of the cylinder 32 will reciprocate the roll housing 15 in stationary housing 10.

A tapered mandrel 35 is disposed in the pass of the working rolls 20. The mandrel 35 is carried by a ball and socket joint 36 at the end of the housing 10 which permits rotation but not longitudinal movement thereof.

The rotatable spindle 7 of the clamping and rotating device 8 is slidably mounted in and keyed for rotation with a rotatable barrel 40 mounted in bearings 41. Attached to the inner end of the spindle 7 are a pair of arms 42 connected to the mid-portion of toggles 43. The upper ends of the toggles 43 are pivotally connected to an insert 44 slidably mounted in and keyed for rotation with the barrel 40. The lower ends of the toggles are connected to U-shaped frame members 45 in which is mounted a jaw 46. A complementary jaw 47 is fixed to a stud-like portion 48 of the lower portion 49 of insert 44. Forward movement of the insert 44 and the jaws 45 and 47 carried thereby is opposed by springs 50. Thus it is seen that forward movement of the spindle 7 by cylin-

der 3 acting through lever 4 and collar 6 to actuate the bars 42 pulls the upper jaw 46 into clamping engagement with a workpiece by toggles 43, since longitudinal movement of the inserts is opposed by the springs 50. After the jaw 46 firmly engages the workpiece, the reactive force of the springs 50 is overcome and continued movement of the spindle moves the workpiece forwardly. This closes a circuit to motor 52 mounted on frame 2 through contacts 51 and the motor is thereby energized to operate a predetermined amount controlled by a time-controlled relay (not shown). Since the motor 52 has a gear 53 in mesh with a ring gear 54 on the barrel 40, the workpiece is thereby rotated a predetermined amount. The cylinder 3 may then be reversed to open the toggles 43 and allow the springs 50 to return the insert 44 to its original position.

In operation, a tubular workpiece X is longitudinally moved by suitable conveyor means (not shown) through the collar 6 and member 8 between the rolls 20, which are spread apart at the entry end of the housing 10, and onto the tapered mandrel 35. The cylinder 3 is then operated to feed an increment of the workpiece forwardly by member 8, operation of which was hereinbefore described, onto the mandrel 35 and expand the outer end thereof due to its engagement with the tapering surfaces of the mandrel. The cylinder 32 is then operated to move the roll housing 15 in the housing 10 and thereby roll down the workpiece onto the mandrel, causing the metal of the tube to flow in the direction of the roll travel. As soon as the rolls 20 have reached the end of the workpiece, the direction of travel is reversed to bring the roll housing between the diverging surfaces 14 and cause the rolls 20 to be spread apart by the springs 24. Another increment of the workpiece is then fed forwardly onto the mandrel 35 by actuation of the cylinder 3 operating the clamping and rotating device 8 which also causes a partial rotation of the workpiece. The cylinder 32 is again actuated to reciprocate the roll housing and the working rolls 20, and this sequence of operation is followed until a tapered workpiece of the desired length is obtained.

Thus, it is seen that a workpiece having a constant outside diameter which is determined by the semi-circular groove 22 in the rolls 20 and a tapered inside diameter corresponding to the taper on the mandrel 35 is obtained. The mandrel taper may be varied to form a varying interior configuration in the workpiece if desired.

While I have shown and described one specific embodiment of my invention, it will be understood that this embodiment is merely for the purpose of illustration and description and that various other forms may be devised within the scope of my invention, as defined in the appended claims.

I claim:

1. Apparatus for forming metal tubes having a constant outside diameter and a tapered inside diameter which comprises a housing, a pair of spaced parallel trackways which diverge outwardly at the entry end of said housing, a tapered mandrel disposed intermediate said surfaces with the smaller end disposed between said diverging surfaces, a pair of rolls having a circular pass therebetween mounted between said surfaces, means to move said rolls longitudinally between said surfaces, means to spread said rolls apart when they are between said diverging surfaces, and means for advancing a tube onto said mandrel and partially turning same.

2. Apparatus for forming metal tubes having a constant outside diameter and a tapered inside diameter which comprises a housing, a pair of spaced parallel surfaces which diverge outwardly at the entry end of said housing, racks on said surfaces, a tapered mandrel disposed intermediate said surfaces with the smaller end disposed between said diverging surfaces, a pair of backing up rolls having gears engaging said racks, a pair of rolls having a circular pass between said backing up rolls and having gears engaging the gears on said backing up rolls, means to move said rolls along said mandrel whereby they are positively rotated by said racks and gears, means to spread said rolls apart as they pass between said diverging surfaces, and means for advancing and partially turning a tube on said mandrel when said rolls are spaced apart at the entry end of said housing.

3. Apparatus for forming metal tubes having a tapered inside diameter which comprises a housing, a pair of spaced parallel trackways which diverge outwardly at the entry end of said housing, a tapered mandrel disposed intermediate said surfaces with the smaller end disposed between said diverging surfaces, a pair of rolls having a metal working pass therebetween mounted between said surfaces, means to move said rolls longitudinally between said surfaces, means to spread said rolls apart when they are between said diverging surfaces, and means for advancing a tube onto said mandrel and partially turning same.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
185,374	Whitehouse	Dec. 12, 1876
331,576	Tasker	Dec. 1, 1885
1,810,885	Neuberth	June 16, 1931
2,161,065	Krause	June 6, 1939

FOREIGN PATENTS

Number	Country	Date
57,906	Germany	July 29, 1891
521,611	Germany	Mar. 27, 1931