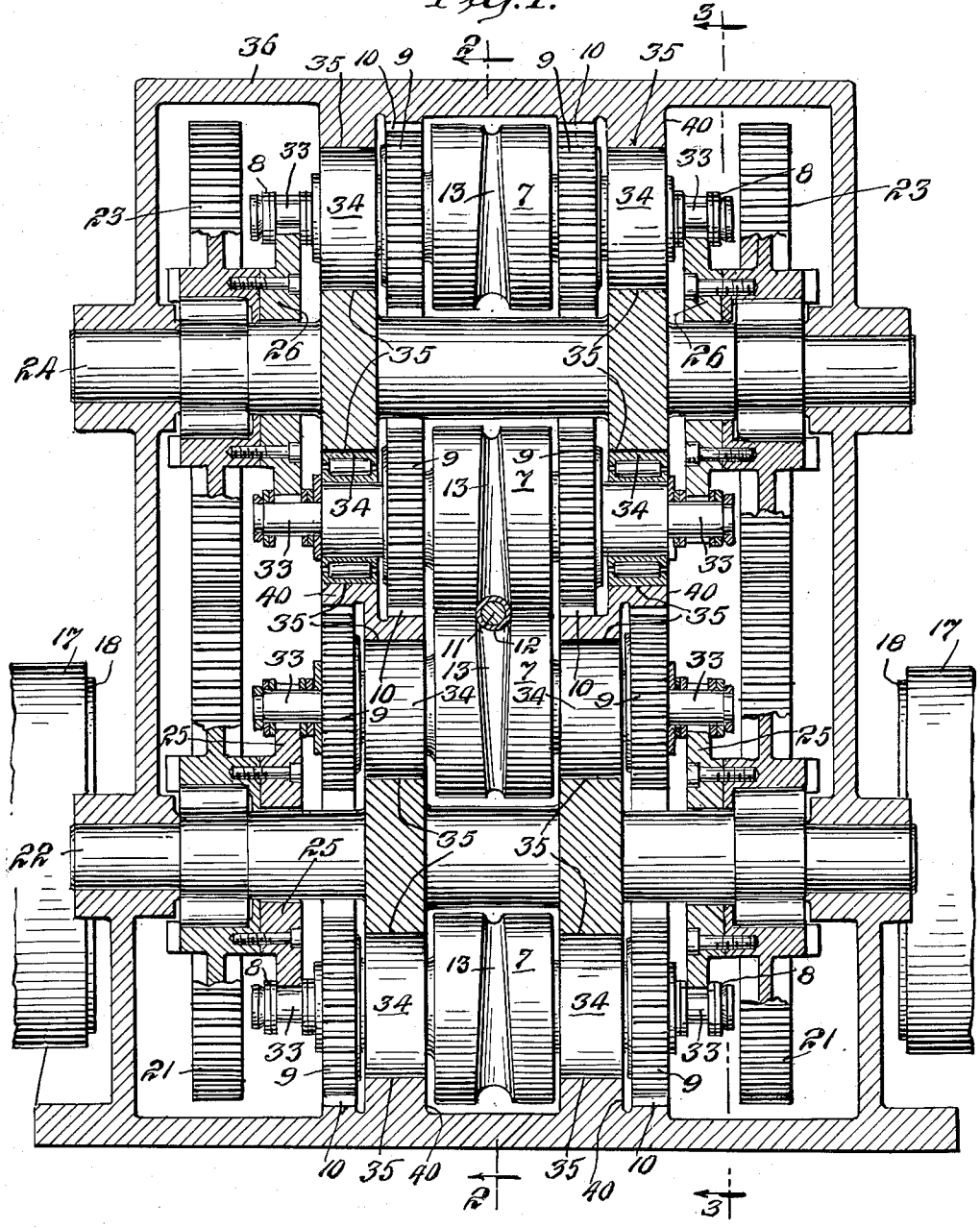
June 20, 1961 P. L. NOWAKOWSKI 2,988,937

TUBE REDUCING MILL

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Fig. 1.



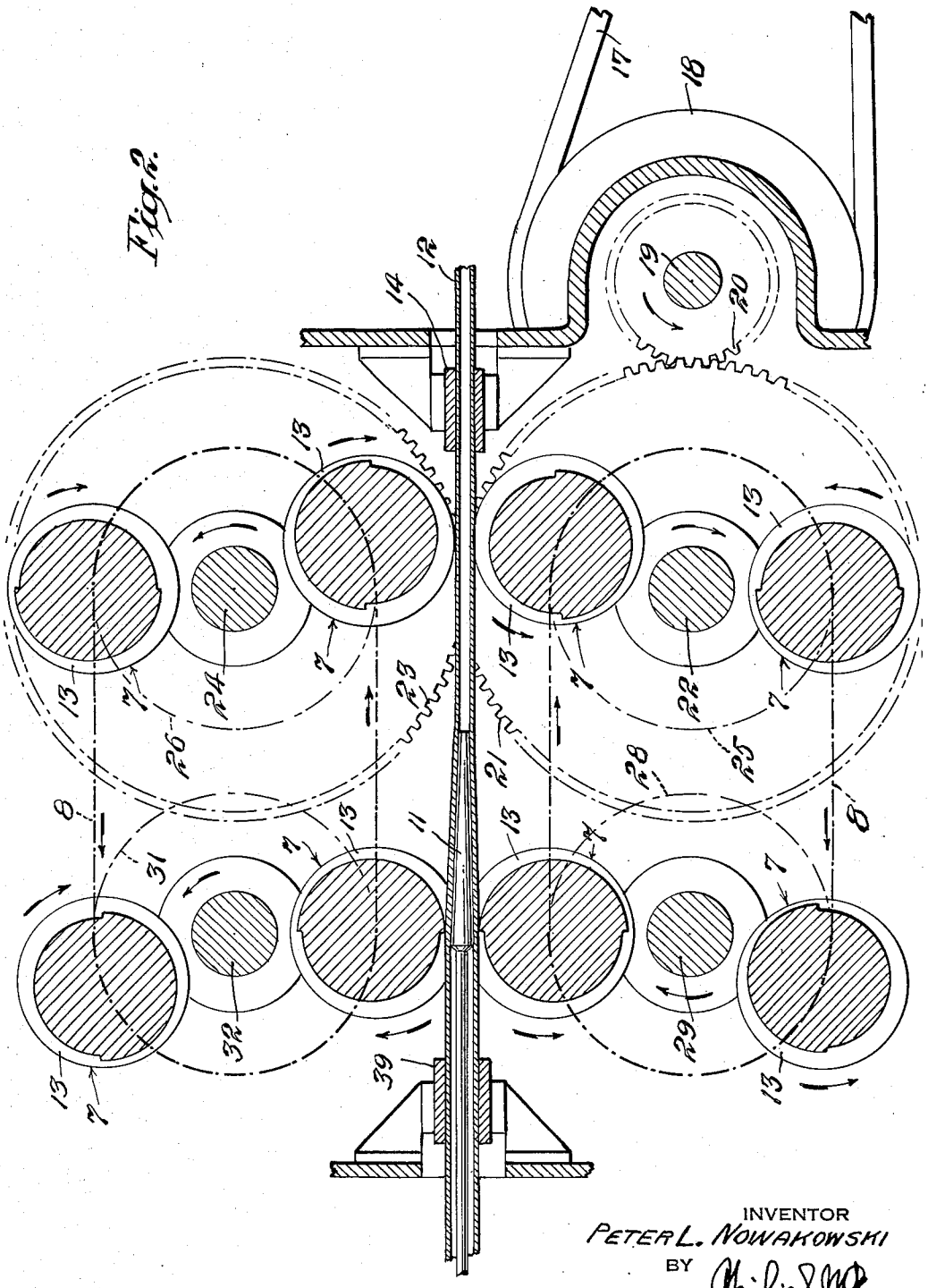
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TUBE REDUCING MILL

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Fig. 2.



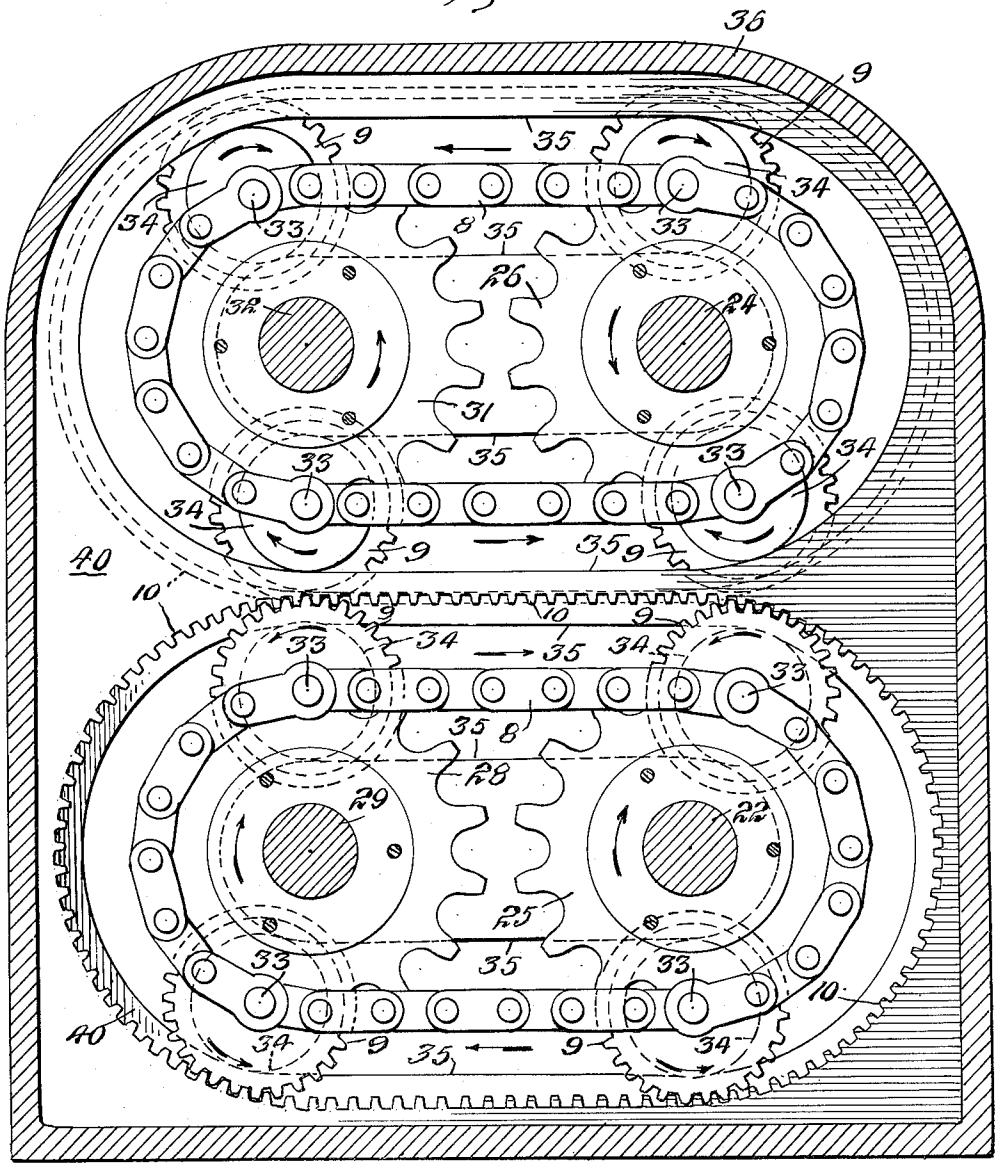
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Fig. 3.



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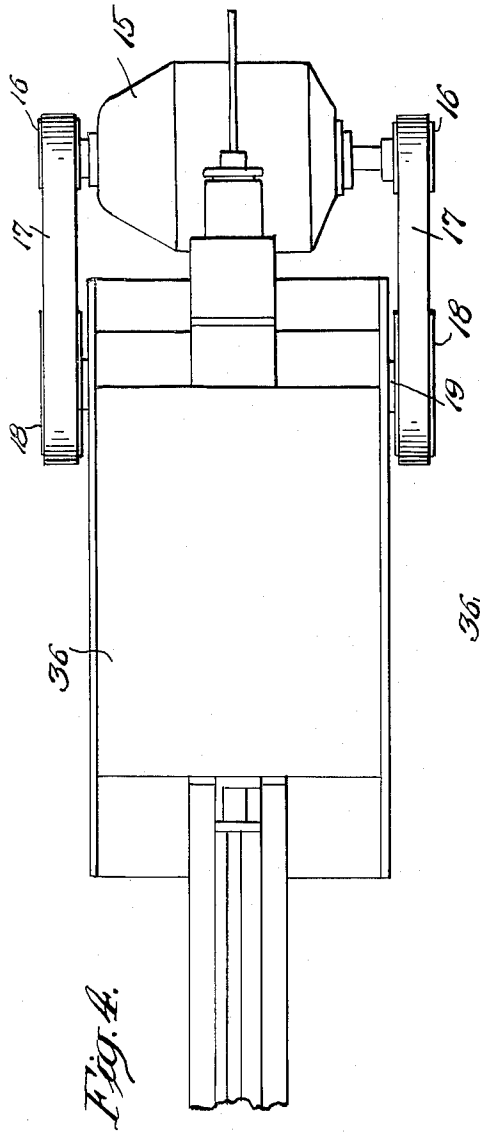


Fig. 4.

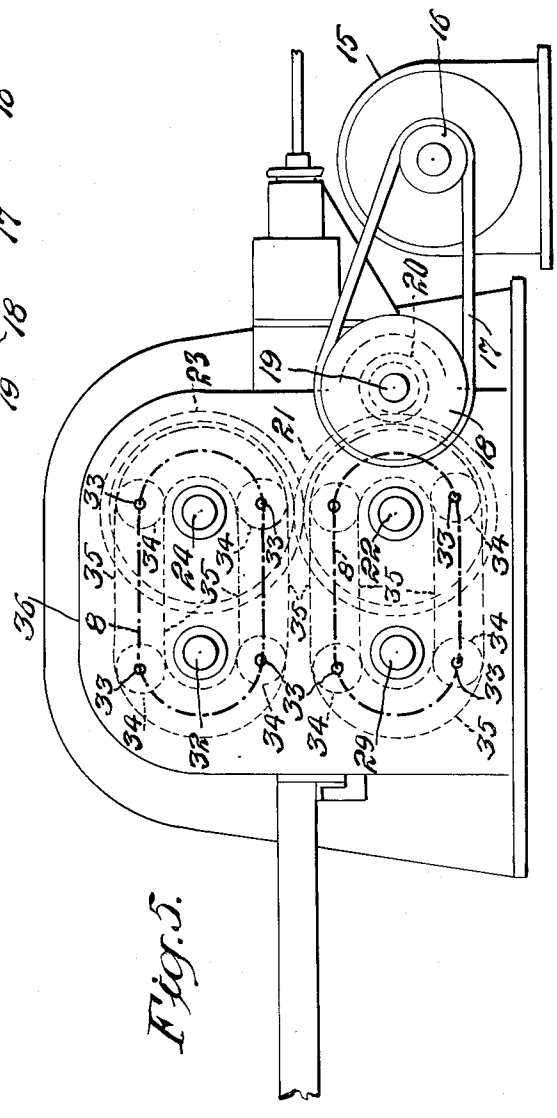


Fig. 5.

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TUBE REDUCING MILL

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3 Claims. (Cl. 80—14)

The invention herein disclosed relates to rolling mills, particularly of the Pilger gapped roll type.

Special objects of the invention are to improve on mills of that order in the way of obtaining more accurate and greater uniformity in wall thickness of the tube, particularly thin wall tubing and in speeding up production operations without imposing too great loads on the machine or harming the product.

Further objects are actually to improve the product by working of the metal and to assure constant uniformity and strength as required in the many special uses of thin wall tubing used for aircraft and various scientific purposes.

These and other like objects have been attained in this invention by special arrangement and operation of companion tube reducing rolls at opposite sides of the tube supporting mandrel and the driving of these rolls in orbital paths toward the end of the mandrel while forcing them to turn in the opposite direction away from the end of the mandrel, thus to roll down the wall thickness in a smooth flowing continuous squeezing action in harmony with travel of the tube off the mandrel.

Further objects of the invention have been to provide such a machine in a fully practical form in which separating forces will be properly taken care of and which on the whole will be of simple rugged construction, well designed to handle the heavy loads to which it is subjected.

The foregoing and other desirable objects have been accomplished by novel features of construction, combinations and relations of parts as indicated above and further disclosed in the following specification and claims.

The drawings accompanying and forming part of the specification are illustrative of a present practical embodiment of the invention but structure and arrangement may be modified and changed all within the true intent and broad scope of the invention as hereinafter defined and claimed.

FIG. 1 in the drawings is a vertical sectional view of a roll stand embodying the invention, this view being taken on a transverse plane across the mandrel and substantially intersecting the axes of the upper and lower main shafts.

FIG. 2 is a longitudinal sectional view on substantially the plane of line 2—2 of FIG. 1 with parts broken away and with arrows indicating rotative movement of the reducing pairs of rolls and the orbital travel of such rolls.

FIG. 3 is a vertical sectional view on substantially the plane of line 3—3 of FIG. 1 showing the chain and sprocket mounting and orbital drive of the rolls and the stationary rack or pinion rotational drive for the rolls.

FIG. 4 is a plan view showing how the gearing at opposite sides of the machine is driven from separate pinions on opposite ends of the main drive shaft.

FIG. 5 is a broken side elevation and partly diagrammatic view of the machine.

In the several views the reducing rolls **7** are shown as Pilger type gapped rolls but instead of being mounted in stationary bearings as has heretofore been the practice these rolls are carried by endless chains **8** to travel them in an orbital path and are given independent rotation by providing them with pinions **9** riding stationary oval racks **10** corresponding to the orbital paths of travel.

In the course of such travel companion rolls come together in cooperating pairs at opposite sides of the mandrel **11** as shown at the left in FIG. 2 and proceed along with the tube **12** down the taper of the mandrel to complete the reduction by the cam grooves **13** and to advance the finished tube out through the front guide **14**.

The drive for accomplishing the foregoing is shown as comprising a motor **15** having pulleys **16** at opposite ends of its shaft connected by V belts **17** with pulleys **18** on opposite ends of a main drive shaft **19** carrying pinions **20** near its opposite ends in mesh with the main drive gears **21** at opposite sides of the machine.

Gears **21** are shown journaled on opposite ends of a fixed supporting shaft **22** and as in mesh with companion gears **23** journaled on opposite ends of a stationary upper supporting shaft **24**.

The lower gears **21** carry sprocket gears **25** at their inner sides and the upper gears **23** carry similar sprocket gears **26** at their inner sides.

Roll carrying sprocket chains **8** extend from sprockets **25** about corresponding sprockets **28** on shaft **29** parallel to shaft **22** and similar roll carrying sprocket chains **8** extend from drive sprockets **26** about corresponding sprockets **31** on shaft **32**, parallel with shaft **24**.

The reducing rolls are journaled in equally spaced relation between the pairs of upper and lower drive chains at opposite sides of the machine on the centers indicated at **33**, FIG. 3, four rolls in this instance to each pair of chains.

The separating forces are transmitted by the rolls to the stationary frame or body of the machine through the provision of roller bearings **34** of ample size at opposite ends of each roll riding over stationary oval tracks **35**, FIG. 3, carried by or forming part of the massive base structure **36**.

Rotation is imparted to the rolls by provision of the rolls with the pinions **9** at opposite ends of the same in riding driven engagement with the stationary oval racks **10** corresponding in outline to the orbital travel of the drive chains.

FIG. 1 shows how the roll turning pinions on the upper set of rolls are located at the inner sides of the load carrying bearings **34** with the racks close at the sides of the rolls and the drive pinions of the lower set of rolls at the outer sides of bearings **34** and the racks for the same further spaced from the ends of those rolls thus offsetting the rack and pinion drive of one set of rolls from the rack and pinion drive of the other set of rolls.

In the same fashion the bearing tracks for the upper and lower sets of rolls are reversely offset with the tracks for the upper rolls spaced more widely apart than the similar tracks for the lower rolls.

FIG. 1 shows how the reversely offset racks **10** and tracks **35** may be provided at the upper and lower sides of heavy webs **40** carried by the base or frame structure.

At the end of each working pass, with the companion rolls in gapped relation, the mandrel and tube may be rocked or turned to enable ironing out of any fin and the tube be advanced for the next cycle of operations.

The mechanism for feeding and turning is not shown here, it being of special design, timed to cooperate with the orbital and rotative movements of the reducing rolls.

In FIG. 2 the tube, prior to reduction is shown as supported and directed by a stationary guide **39**.

The racks provide an exact control, maintaining even uniform surface speed of the rolls at the point of contact and at the same or possibly greater or less speed of travel along the mandrel and keep the rolls always in exact synchronism.

The tapered and cylindrical end portions of the mandrel may be varied as well as the die grooves in the rolls to control the rate and extent of reduction.

The bearing tracks for the rolls serve to keep the drive pinions of the rolls accurately meshed with the stationary racks so that the operation is smooth and continuous with no undue strain or wear on any of the parts.

While for most purposes the reducing rolls, traveling in their orbital paths, may be supported by the roller bearings on the ends of these rolls riding on stationary orbital tracks as here shown, for heavier work where the separating forces are greater, the reducing rolls may be mounted in carriers carrying special backup rolls.

The orbital drive for the companion pairs of the reducing rolls have been here shown as endless chains but it is appreciated that other forms of endless drive connections may be employed so it will be understood that the term "endless chains" has been used in a broad comprehensive sense and it is intended that other terms here used shall be so understood.

What is claimed is:

1. A tube reducing mill comprising a mandrel having a tapered end portion with the larger end of the same the size of the tube to be reduced and the smaller end the size of the tube after reduction, means for supporting said mandrel stationary during the reducing pass, companion die rolls at opposite sides of said mandrel having cam grooves tapering from deep to shallow ends, means for bodily advancing said die rolls over said tapered end portion of said mandrel and means for driving said companion die rolls in the opposite direction from said advancing movement timed to bring the deeper ends of the cam grooves in the rolls into register with the larger end of the mandrel taper and the shallow ends of the grooves into register with the smaller end of the mandrel taper as said rolls in their advancing movement come into alignment with said larger and smaller end portions of the taper in the stationary mandrel, said means for driving said companion die rolls comprising pinions on the ends of said die rolls, stationary oval racks engaged by said pinions, corresponding stationary oval tracks alongside said racks, rollers on the die rolls in rolling engagement with said tracks, the tracks and rollers for one die roll being arranged immediately adjoining that die roll with the pinions for that die roll at the outer sides of the rollers on that die roll and the pinions for the companion die roll being located immediately adjoining that die roll and the rollers and tracks for the latter die roll being located at the outer sides of the pinions on that die roll, said oval tracks and racks having runs extending longitudinally of the mandrel whereby to maintain said die rolls in cooperative relation with the mandrel in the advancing movement of the die rolls along the mandrel.

2. Tube reducing mill comprising the combination of a tapered mandrel, cam groove die rolls at opposite sides of said mandrel and cooperative therewith to effect reduction of tubing on said mandrel, said die rolls being opposed in pairs traveling longitudinally of the mandrel and means for effecting synchronized operation of said die rolls comprising stationary spaced parallel oval guide tracks at opposite ends of the die rolls at one side of the mandrel, similar stationary spaced parallel oval guide tracks at the ends of the die rolls at the opposite side of the mandrel, stationary oval gear racks of corresponding outline at the sides of said guide tracks, pinions on the ends of said die rolls in meshing engagement with said oval racks, bearings on the ends of the die rolls at one side of the pinions thereon in rolling engagement with said guide tracks, said guide tracks and racks having runs extending longitudinally of the mandrel whereby to maintain said die rolls in cooperative relation with the mandrel in the longitudinal travel of the die rolls along the mandrel and means for traversing the companion pairs of die rolls in sequential order along the mandrel and in the oval paths defined by said oval tracks synchronized in cooperative pairs by the pinions held in driven engagement with the gear racks by the bearings engaged with the guide tracks.

3. The invention according to claim 2 in which said means for traversing the die rolls in cooperative pairs includes synchronously rotating gears and pull connections extending from said gears to the ends of said die rolls.

References Cited in the file of this patent

UNITED STATES PATENTS

800,950	Somers	Oct. 3, 1905
1,013,429	Nowak	Jan. 2, 1912
1,622,744	Stiefel	Mar. 29, 1927
2,125,686	Norton	Aug. 2, 1938
2,684,000	Holtz	July 20, 1954
2,709,934	Platzer	June 7, 1955
2,780,948	Fredriksson	Feb. 12, 1957

FOREIGN PATENTS

908,849	Germany	Apr. 12, 1954
G10,435	Germany	Nov. 3, 1955
1,005,919	Germany	Apr. 11, 1957