N. S. HARTER.

METHOD OF AND APPARATUS FOR FORMING FLEXIBLE TUBES.

APPLICATION FILED OCT. 20, 1910.

1,042,552. Patented Oct. 29, 1912.

4 SHEETS—SHEET 1.

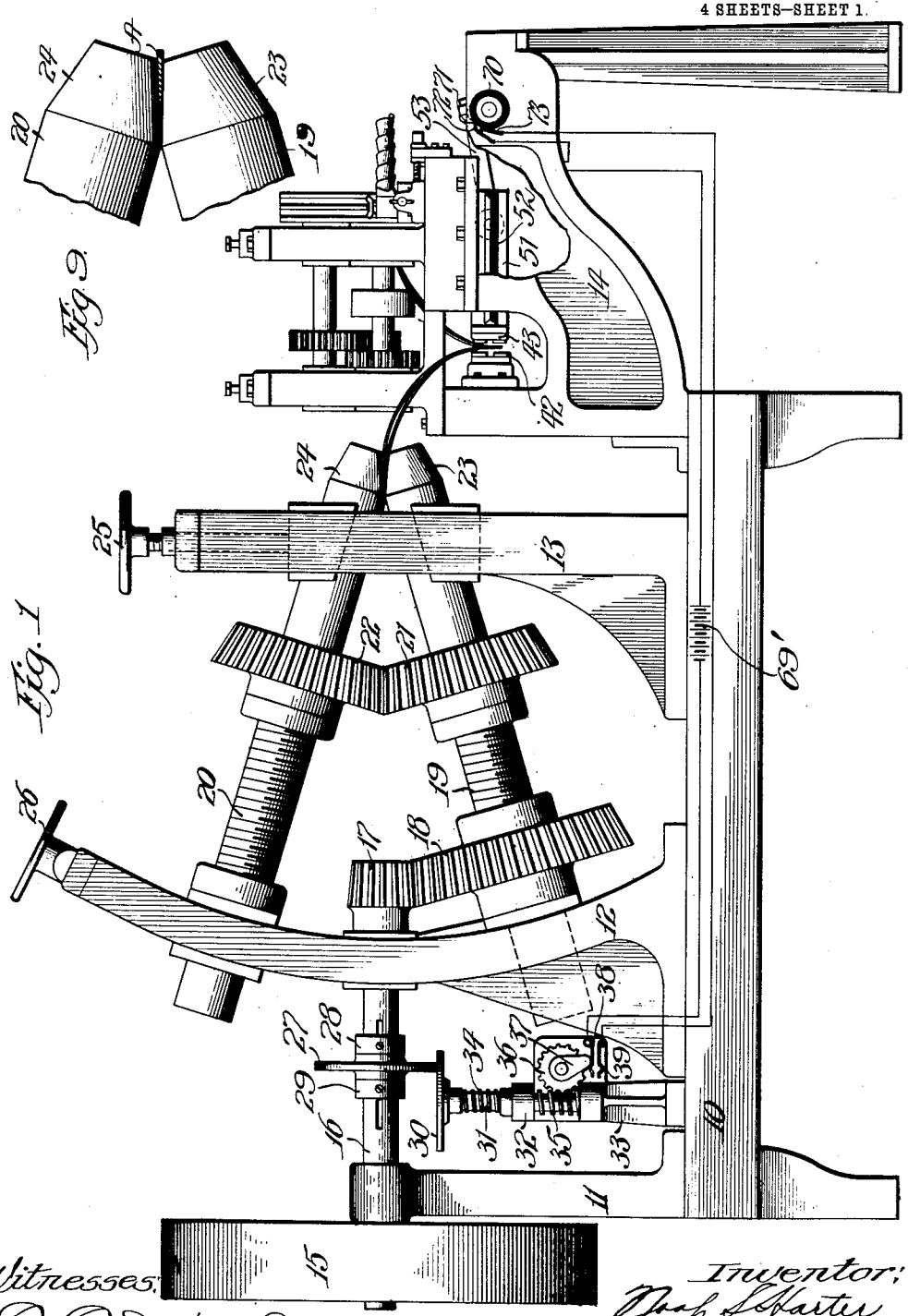

Fig. 1

Fig. 9

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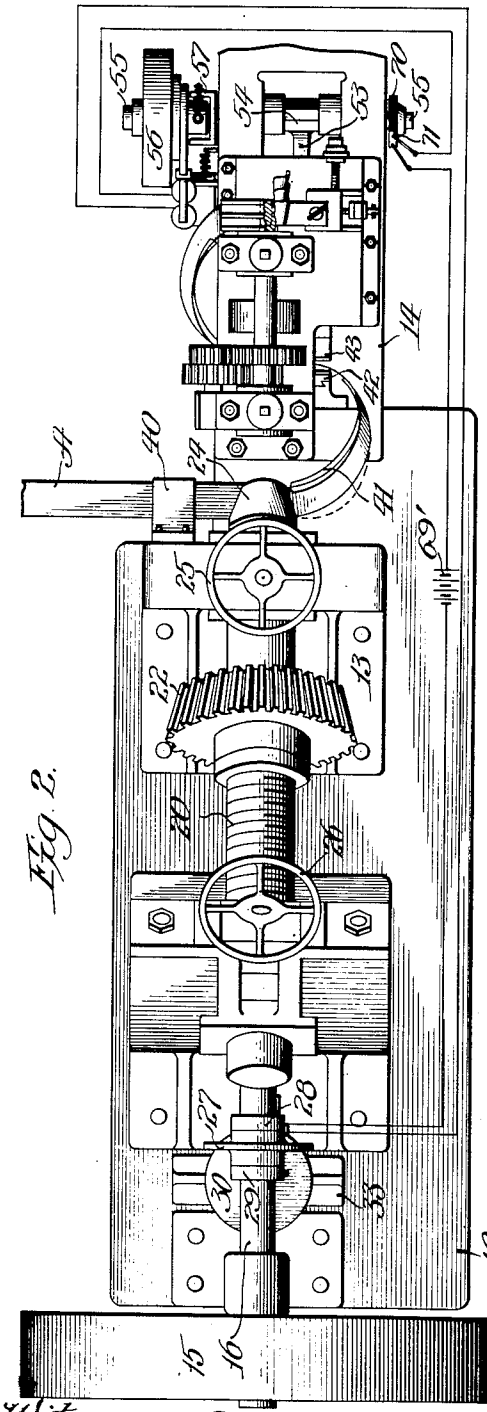

Fig. 2.

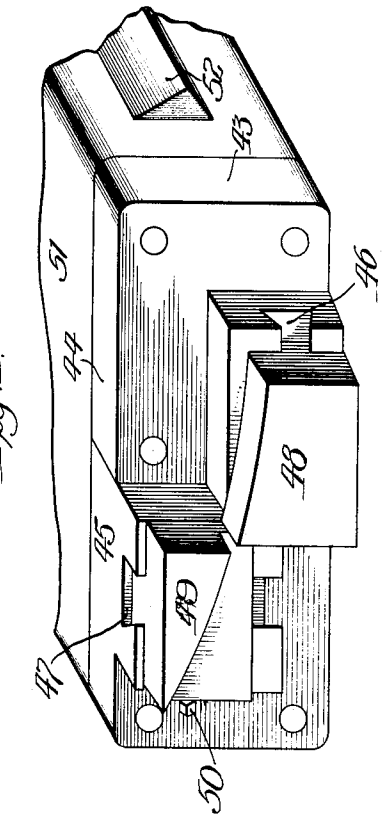

Fig. 4.

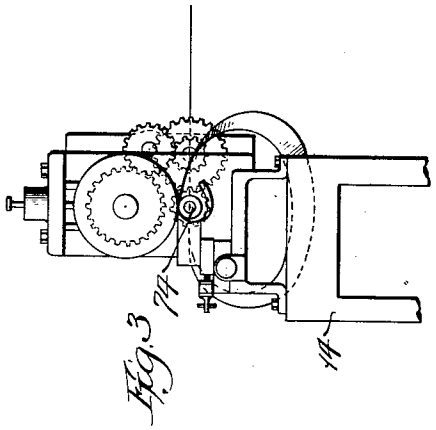

Fig. 3.

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4 SHEETS—SHEET 3.

Fig. 7.

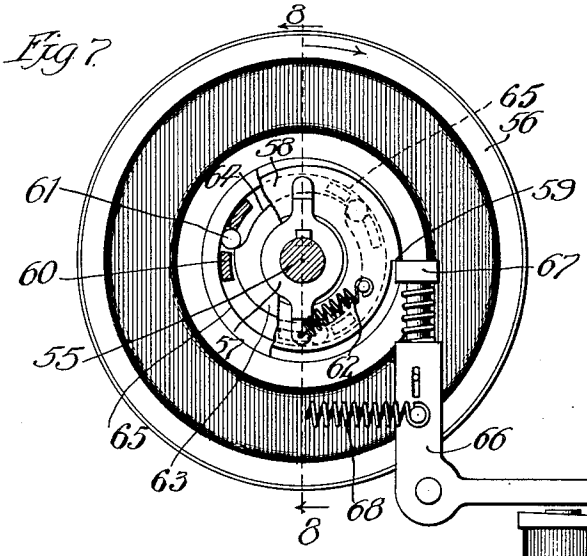
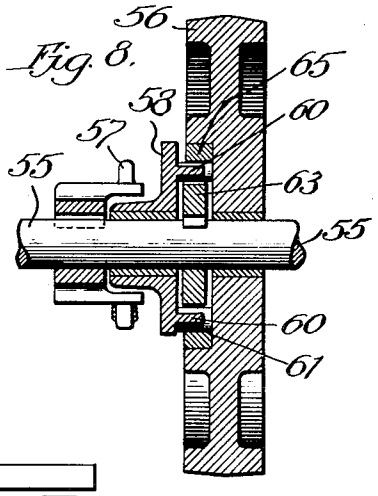


Fig. 8.



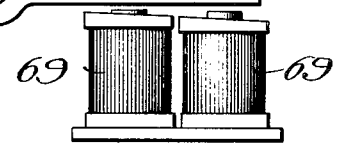


Fig. 6.

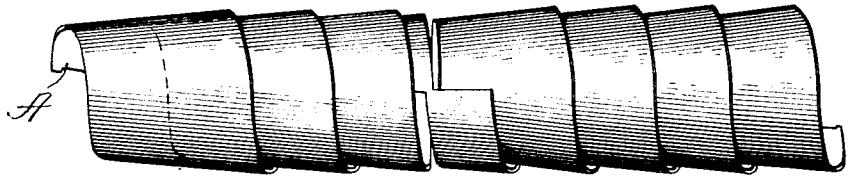
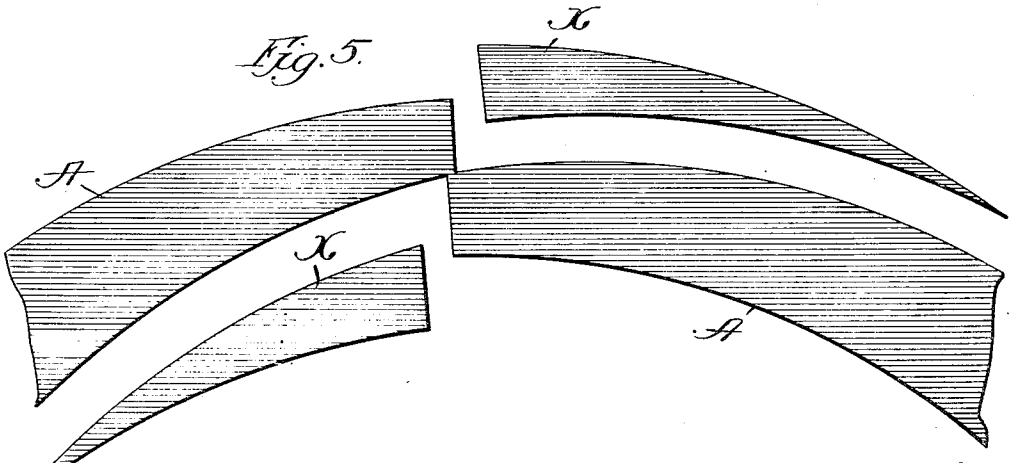


Fig. 5.



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4 SHEETS—SHEET 4.

Fig. 10.

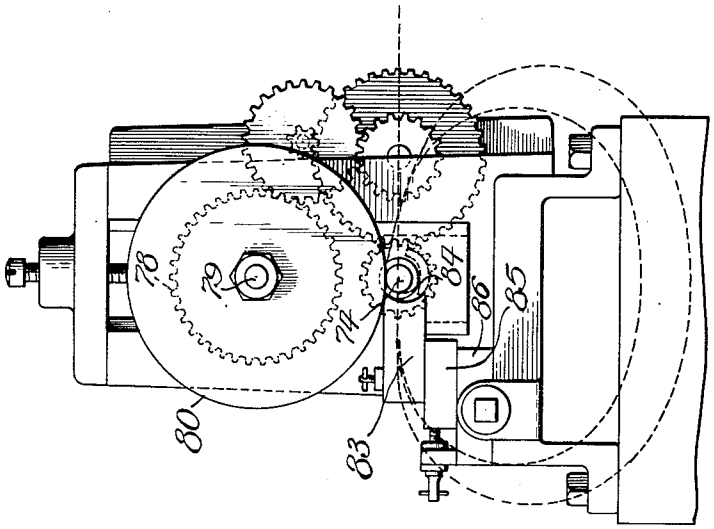
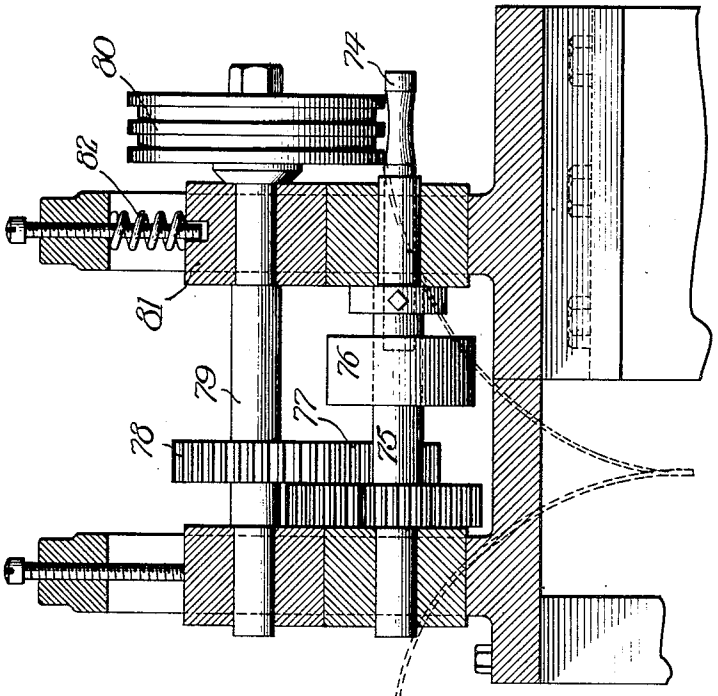


Fig. 11.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR FORMING FLEXIBLE TUBES.

1,042,552. Specification of Letters Patent. Patented Oct. 29, 1912.

Application filed October 20, 1910. Serial No. 588,207.

To all whom it may concern:

Be it known that I, NOAH S. HARTER, a citizen of the United States, residing at Waukegan, in the county of Lake and State of Illinois, have invented certain new and useful Improvements in Methods of and Apparatus for Forming Flexible Tubes, of which the following is a specification.

My invention relates to a method of and apparatus for forming flexible tubes or conduits from straight flat wire and has particular reference to apparatus of this sort which shall be provided with means for elongating the marginal portion of the strip fed thereunto; then trimming and partially severing blanks from said strip; then coiling the strip around a mandrel; then separating the coiled tubes by severing the uniting web between the adjacent sections.

One of the objects of my invention is the provision of apparatus having readily adjustable means for elongating or rolling a marginal portion of a strip of metal fed thereinto.

A further object is the provision of novel means of trimming and partially severing blanks, these means comprising a reciprocating die thrown into operation by a clutch which is electrically operated at pre-determined intervals.

Further and more particular objects will appear hereinafter.

Referring to the drawings: Figure 1 is a side elevation of my improved device; Fig. 2 is a top plan view thereof; Fig. 3 is a partial end view; Fig. 4 is a perspective end view of the movable dies for separating the blanks; Fig. 5 is a fragmentary section of the end portions of two blanks showing sections trimmed therefrom by the action of the die shown in Fig. 4; Fig. 6 is a view of two tubes or conduits formed from the blanks shown in Fig. 5 and before separation; Fig. 7 is a view of the novel clutch for operating the die; Fig. 8 is a transverse section on the line 8—8 of Fig. 7, Fig. 9 is a fragmentary view showing the method of rolling the strip. Fig. 10 is an end elevation of the coiling means, and Fig. 11 is a central, vertical section through Fig. 10.

Referring more particularly to the drawings, it will be seen that the device is supported upon a base 10, having an upright 11, and housings 12—13. An extension 14, forming part of the main frame, supports the die, the operating means and the coiling mandrel. Power is applied to the device through the pulley 15, keyed to the shaft 16, said shaft having a pinion 17, on its overhung end, said pinion meshing with a gear 18, keyed to the obliquely mounted shaft 19, one end of which is mounted in bearings in the housing 12, and the other end in bearings in the housing 13. A reversely mounted shaft 20, is also mounted in bearings in the housings 12—13, gears 21—22 transferring motion from the shaft 19, to the shaft 20. The shafts 19 and 20 are threaded to provide for longitudinal adjustment of the gears and also for the adjustment of the shafts in their bearings.

As will be seen by reference to Fig. 1, the shafts 19—20, converge, their convergent ends being tapered as at 23—24, for the purpose of providing rolls adapted to perform the required functions. The upper shaft 20, is adapted for adjustment in both the upright 12 and the housing 13, as by hand-wheels 26—25. By the operation of these hand-wheels the angle of inclination of the shaft 20 may be varied.

The shaft 16, is provided with a disk 27, mounted for longitudinal adjustment by means of the collars 28—29. This disk 27, is in peripheral frictional engagement with a disk 30, mounted on a shaft 31, in bearings 32, on a bracket 33, on the frame 10, a compression spring 34 being provided to cause the upward thrust of disk 30 against the disk 27. The shaft 31, is provided with a worm 35, coöperating with a gear 36, mounted for rotation on a part of the frame, this gear carrying an arm 37, adapted to operate electrical contacts 38—39, for a purpose to be hereinafter described.

A flat ribbon or strip of metal such as

shown at A, in Fig. 2, is fed to the machine from a suitable source of supply. This flat strip is rectangular in cross section and may be of the commercial form of flat wire. This strip is fed between the rolls 23—24, through the guide 40, the rolls 23—24 not presenting any opening there-between which is of the same vertical dimension at any two points. In other words, the opening is triangular or wedge-shaped, as best shown in Fig. 9. As will be understood, the operation of rolling one edge or a marginal strip of the ribbon material tends to elongate the edge thus rolled. After being thus rolled, the strip A follows a guide 41, and passes between the dies about to be described. These cutting dies comprise the female member 42, and the male member 43, the part 42 being rigidly mounted on the frame 14. The die 43, as best shown in Fig. 4, is composed of the parts 44—45, having right-angled, dove-tailed slots 46—47, formed on their face. Within these slots are slidably mounted the dies 48—49, held in adjusted position by means of set screws, one of which is shown at 50. The die 43 is properly secured to a reciprocating member 51, having guide ribs 52 on the sides thereof, these guide ribs co-acting with slots in the frame 14. The part 51 is adapted to be reciprocated by means of the connecting rod 53 connected to the crank 54 on a shaft 55. Power is applied to a pulley 56, the same being constantly rotated. A clutch is interposed between the pulley 56 and the shaft 55 in order that the dies may be operated at regular intervals. As will be understood, the operation of the machine is very rapid and as the feed of the strip A to the rolls is constant, the reciprocation of the die must be exceedingly rapid in order that the strip of metal between the rolls and the die may not be caused to buckle unnecessarily. Therefore the pulley 56, is operated at a high rate of speed in order that the reciprocating die may not intercept the travel of material for more than a very brief space of time.

As will be seen, the clutch is electrically operated and comprises a part 57, keyed to the shaft 55, a member 58, loosely mounted on the shaft 55, and having a hook or tooth 59, on its periphery. Inwardly extending lugs or projections 60, are provided on the part 58, between which are mounted rollers 61. The parts 58 and 57, are connected by a tension spring 62. Also keyed to the shaft 55, is a part 63, having a series of cam surfaces 64, so shaped that the opening between these surfaces and the inner surface of the wearing plate 65 of the wheel 56, is at one part less than the diameter of the roll 61. The parts are firmly held in the position shown in Fig. 7 by means of the pivoted arm 66, having a cushioned stop 67, and held in operative relation to the part 58, by means of the tension spring 68, one end of which is attached to the arm 66, and the other end to the frame of the machine.

As will be seen, when the stop 67, is removed from the tooth 59 on the part 58, the said part 58 will be caused to turn by the action of the spring 62, the lugs 60, on the part 58, will wedge the rolls 61, between the cam surface 64, and the inner wearing surface 65 of the pulley 56, causing the shaft 55 to turn with the wheel for one revolution. As soon, however, as the parts have made one complete revolution the stop 67 will catch on the tooth 59, the stop 67 being cushioned by the spring thereunder, the stopping of the part 58 removing the rollers 61 from between the cam surfaces and the inner surface of the wheel 56. The stop 67, is operated electrically by means of the magnets 69, energy therefor being provided from any suitable source such as batteries 69′. As previously described, the operation of the friction disks 27—30, causes the operation of the contacts 38—39, the length of time between contacts being regulated by the adjustment of the friction disk 27, on the shaft 16. However, it is found in practice that in view of the considerable amount of electrical energy necessary to operate the magnets 69, there is a destructive arc due to the slowness of operation of the contacts 38—39, by the worm 35. Therefore I have provided a second contact on the shaft 55, which is composed of the fiber disk 70, having a brass insert 71, upon which rest two contacts 72—73, when the parts are in the position shown in Fig. 1; that is, while a strip of metal is being fed through the dies. When, however, through the operation of the disks 27—30, contact is made at 38—39, the magnets 69 are energized, the clutch is thrown in and the shaft caused to make one revolution. As soon as the shaft starts to revolve, the contact at 71 is broken instantly and when the contacts 38—39, separate, there is therefore no arc.

The reciprocation of the die causes portions to be cut from the strip of metal such as shown in Fig. 5, the parts X X being waste material. As will be seen, the strip is still united by a thin web of material, this being left for the purpose of assuring the proper guidance of the strip to the point where it engages the mandrel.

A mandrel and suitable coiling means are shown in detail in Figs. 10 and 11. In these views the mandrel 74 is suitably connected to a shaft 75 and adapted to be rotated by means of the belt-pulley 76, connected with any suitable source of power. By means of gearing 77, and gear 78, rigid with shaft 79, motion is transmitted to a

grooved wheel 80, mounted in such manner that its periphery coöperates with the mandrel 74. A bearing 81, within which the shaft 79 is mounted, is provided with an expansion spring 82, in order to permit a small amount of vertical reciprocation to the wheel 80. The strip of material, shown in dotted lines in Figs. 10 and 11, one edge of which has been previously worked on, is adapted to be passed between the mandrel and the wheel 80. An adjustable block 83, having a grooved or helical face 84, causes the strip to assume its spiral form after passing around the mandrel. This block 83 is mounted on other blocks 85, 86, the latter being seated on the main frame of the machine. All of the blocks are adjustable by means of suitable set screws, whereby any size of coil may be formed. As the strip is wound around the mandrel, it assumes the form shown in Fig. 6; that is, one continuous tube joined only by the thin web of material, this web being broken by the attendant as the tube is wound off the mandrel.

The tubes shown in Fig. 6 are only intended as illustrative and do not show the commercial form of the finished product, inasmuch as the tubes are usually very much longer.

It will be understood that the operation of the die may be stopped and a tube may then be rolled and formed of indefinite length.

It will also be understood that various other forms of clutches and die operating means may be employed.

I claim:

1. In an apparatus for forming flexible tubes or conduits from a flat strip or ribbon of metal, the combination of means for reducing the thickness of a longitudinal marginal portion of the strip thereby curving the latter transversely with the thinner edge outermost, means for severing the strip to provide blanks, means for spirally coiling the strip of metal, and operating means to actuate said reducing, severing and coiling means, substantially as described.

2. In an apparatus for forming flexible tubes or conduits from a flat strip or ribbon of metal, the combination of means for reducing the thickness of a longitudinal marginal portion of the strip thereby curving the latter transversely with the thinner edge outermost, means for cutting the strip to provide a series of connected blanks, means for spirally coiling such strip of blanks, and operating means to actuate said reducing, severing, and coiling means, substantially as described.

3. In an apparatus for forming flexible tubes or conduits from a flat strip or ribbon of metal, the combination of rolling means for reducing the thickness of a longitudinal marginal portion of the strip thereby curving the latter transversely with the thinner edge outermost, means for cutting the strip to provide a series of connected blanks, means for spirally coiling such strip of connected blanks with the coils overlapping, and operating means to actuate said rolling, cutting, and coiling means, substantially as described.

4. In an apparatus for forming flexible tubes or conduits from a flat strip or ribbon of metal, the combination of continuously-acting, rolling means for reducing the thickness of a longitudinal marginal portion of the strip thereby curving the latter transversely with the thinner edge of greater diameter, intermittently operated cutting means acting on said strip to provide a series of connected blanks therefrom, means for spirally coiling such strips or blanks with the coils overlapped, and operating means to actuate said rolling, cutting, and coiling means, substantially as described.

5. An apparatus for forming flexible tubes from a flat strip of metal, comprising in combination rolling means for reducing the thickness of a portion of the strip, intermittently operated cutting means acting on said strip to provide a series of connected blanks therefrom, means for spirally coiling said strips or blanks, actuating means for said rolling, cutting and coiling means, the actuating means for said intermittently operated cutting means including an electrically operated clutch, substantially as described.

6. Flexible tube forming apparatus, comprising in combination, means for reducing a portion of a strip of metal, intermittently operated means for cutting blanks from said strip of metal, means for coiling said blanks, said means for reducing said strip of metal comprising convergent shafts, and means for operating said shafts, said blank-cutting and said coiling means, substantially as described.

7. Flexible tube forming apparatus, comprising in combination, diagonally mounted shafts provided with rolling surfaces at their convergent ends, an intermittently operated die, a coiling mandrel, and means for operating said rolls, said die and said mandrel, substantially as described.

8. Flexible tube forming apparatus, comprising in combination, diagonally mounted convergent shafts having rolls upon their convergent ends, an intermittently operated die, a coiling mandrel, means for operating said rolls, die and mandrel, said operating means for said die including an electrically actuated clutch, substantially as described.

9. Flexible tube forming apparatus, comprising in combination, diagonally mounted convergent shafts having rolls upon their

convergent ends, an intermittently operated die, a coiling mandrel, means for operating said rolls, die and mandrel, said operating means for said die being intermittently actuated through a clutch electrically connected to the roll-operating means, substantially as described.

10. The method of forming flexible tubes from a flat strip or ribbon of metal which consists in reducing the thickness of a longitudinal portion of such strip, removing sections of the strip leaving the remaining sections joined together by relatively small connecting parts, spirally coiling the strip with the coils overlapping, and dividing said connecting parts to separate the tubes one from another, substantially as described.

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