Aug. 23, 1938. W. G. BOND 2,127,857

EXTRUDING MACHINE

Original Filed Jan. 26, 1933 2 Sheets-Sheet 1

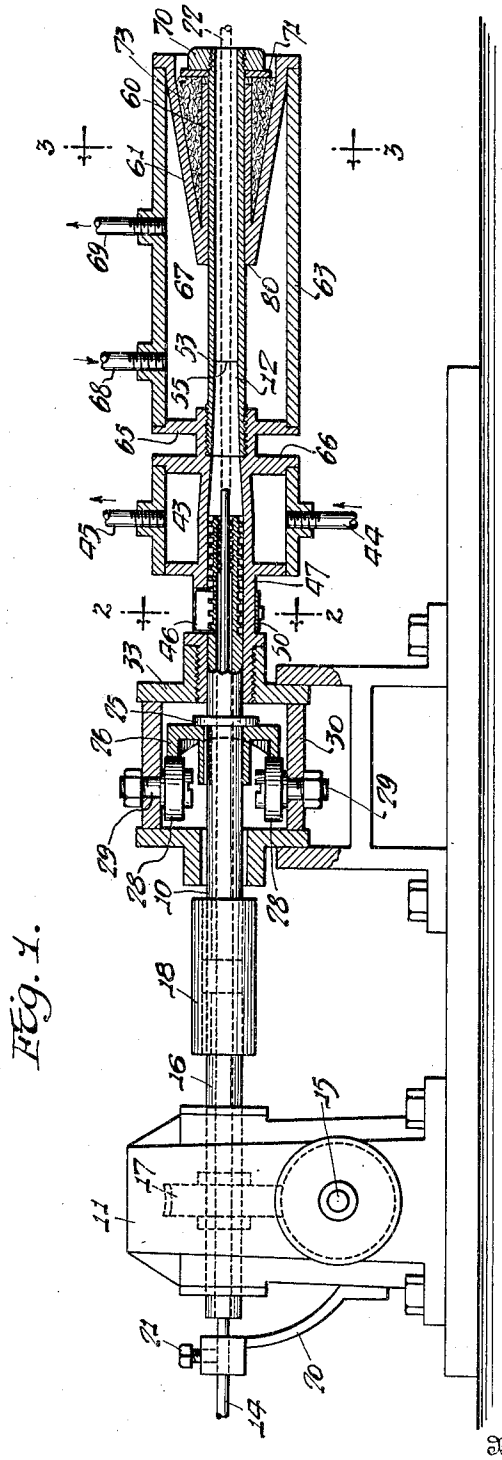


Fig. 1.

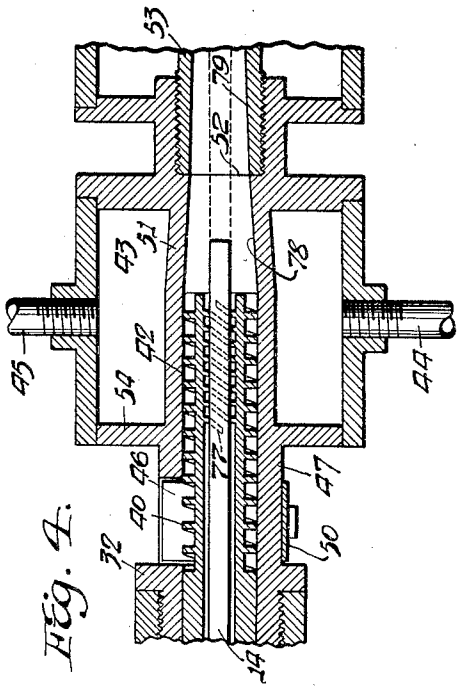


Fig. 4.

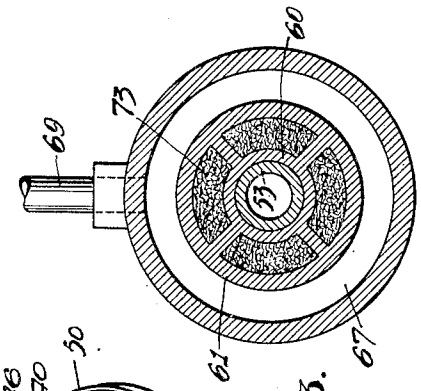


Fig. 3.

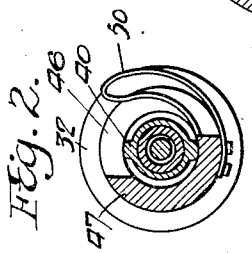


Fig. 2.

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EXTRUDING MACHINE

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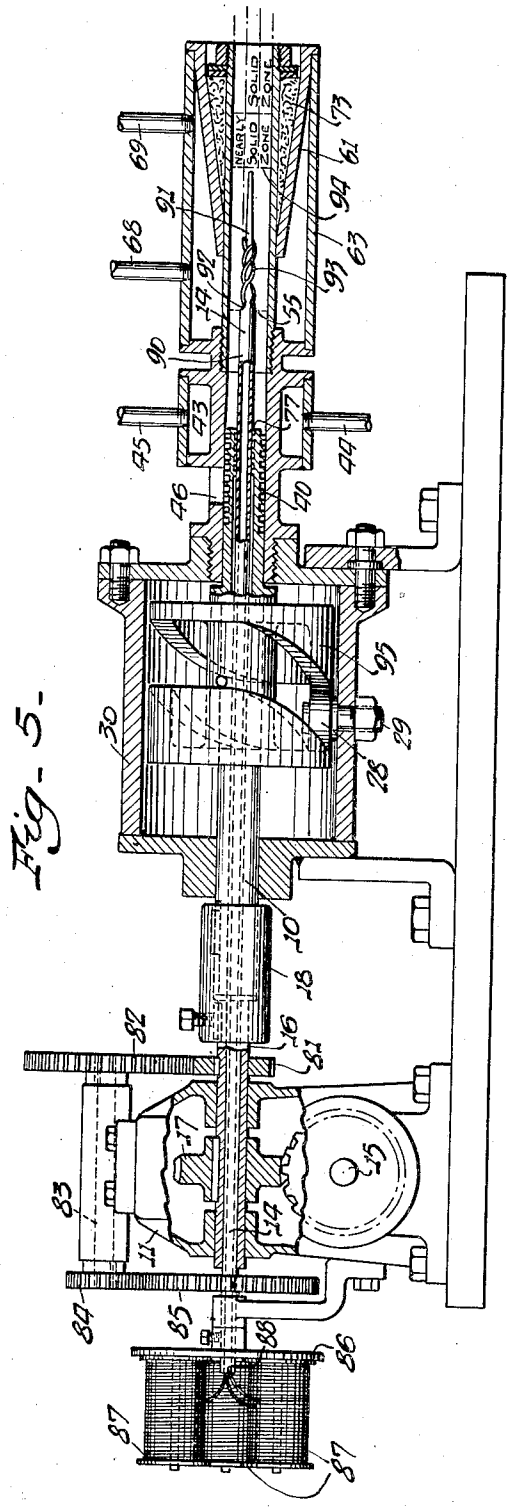


Fig. 5.



Fig. 10.

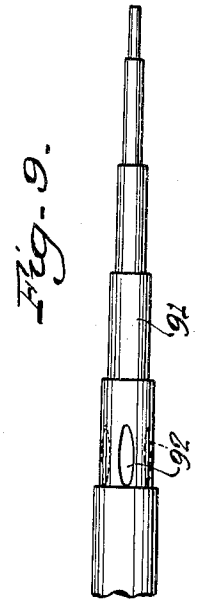


Fig. 9.



Fig. 6.

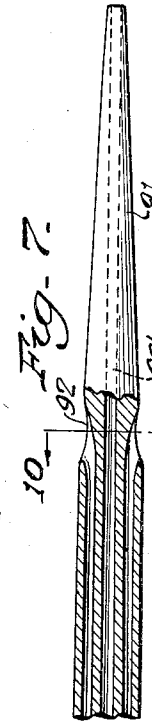


Fig. 7.



Fig. 8.

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EXTRUDING MACHINE

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Renewed January 27, 1937

29 Claims. (Cl. 18—13)

This invention relates to extrusion machines and has for its principal object the provision of a method and apparatus for applying to a wire or core a covering preferably of insulating type which is deposited around the central wire or tube by an extrusion method at a low cost. In the making of insulated wire many different coverings have been tried and many different processes of applying the covering have also been used. While some of the coated wires are excellent for one purpose or another, there is no covered wire which is adaptable to widely varying uses and these processes which yield a rather satisfactory product are expensive to operate.

In the present invention I can perform the process very cheaply and can produce not only low voltage insulation but I can produce a high voltage insulated wire of a quality equal to and I believe even surpassing most of the present day wires and at a cost materially less than is now obtained. An important feature of the present invention is the provision of a method and apparatus for applying a high grade insulation to an electric conducting cable with the insulation material heat treated while under the pressure and in the forming die and without bending the cable or reeling it during the application of or heat treating of the said material. My method also contemplates the making by an extrusion process of a tape or ribbon and applying this extruded tape to the wire as in a paper taping machine. Further applications are composition cork, insulation, pencil, caster rolls, ceramics, hose, etc.

In the drawings I have shown two embodiments of my invention which serve to illustrate the process, the machine being the one which is my preferred form at the present time.

Figure 1 is a side elevation partly in central section of one form of machine for embodying my process.

Figures 2 and 3 are transverse sections on the lines 2—2 and 3—3 of Figure 1 showing respectively the feed intake and the final zone.

Figure 4 is an enlarged section thru the feed end of the worm shaft.

Figure 5 shows a modified form.

Figures 6, 7, 8 and 9 are modified forms of mandrels.

Figure 10 is a cross section on line 10—10 of Figure 7.

My device consists primarily in a feed shaft 10 of worm type, driving mechanism 11 for turning this shaft, a forming tube 12, a guide tube 14, and heating and cooling chambers as is required for the solidifying of the extruded material.

The driving mechanism for the screw consists of a standard speed change mechanism, the particular reducer 11 shown in Figure 1 giving a ratio of about twenty to one. This device receives its power from the shaft 15 so as to turn the feed shaft 10 at a selected speed by means of a short section 16 non-rotatably secured to the gear 17 of the reducer and the coupling 18. A bracket 20 secured to the reducer adjustably holds in place the tube 14 by means of a set screw 21 whereby this guide tube 14 may be held in the position shown in full line when covering a core as in making a cable wire or a pencil but being extended thru the entire device as shown by the dotted line 22 when forming a tube of the extruded material, for example, a flexible pipe or hose.

The feed shaft 10 is non-rotatable but slidably secured in the coupling 18 and has an integral or permanently secured collar 25 against which rests the cam 26 which is splined to the feed shaft 10 and engages one or two or even more rollers such as 28 mounted on short studs 29 secured to the cylindrical casing 30 of the intermittent motion mechanism. When the shaft 10 revolves it is constantly urged to the left as seen in Figure 1 by the pressure of the extruded material or the action of the pitch of the worm and is therefore in constant engagement with the rollers 28 and by this engagement the feed shaft 10 is caused to reciprocate when rotated, this action very materially increasing the quality of the extruded covering or piping.

Referring particularly to Figure 4, 32 is a bearing for the feed shaft 10 threaded to the end piece 33 of the intermittent motion housing. The worm 40 is integral with the metal of the shaft 10 and fits snugly in the largest circular bore of the forming tube, this being given the numeral 42 and being the central portion of the chamber 43, this having an inlet 44 for the cold water or other chilling medium and even having an outlet 45. The comminuted material which solidifies upon being heated is fed in any desired way to the opening 46 in the sleeve 47 of the forming tube which, it will be noted, is integral with the threaded bearing 32. A spring 50 resiliently directs the comminuted material or the strips of material into the path of the worm 40 to aid in the feeding. While I prefer comminuted material I have been very successful with other materials including insulating material

suitable for extrusion work consisting of strips of prepared substances.

The forming tube is tapered as at 51 to the joint 52 between the rear portion 53 of the forming tube and the front portion which in the particular machine illustrated is integral with the side walls 54 of the cooling chamber 43 and also with the bearing 32. The rear section 53 of the forming tube continues its taper but at a less degree up to the point 55. This portion of the taper, that is, the portion of the taper where extruded material is in contact with core or wire, serves to add tension to the core due to speed of extruded material being slower at this point than at exit end of tube 12, because of difference in area and the fact that material is gripping more at the exit end. Under rare conditions where a push action is desired on core or wire this is accomplished by reversing the direction of taper of this end of the rear section of the forming tube. This action of varying the speed of various sections of the formed material is also useful in making material without a core. I prefer the forming tube to be made of bronze or brass and find it very helpful to plate the interior of this tube with a hard substance such as chromium. If the forming tube were made of other metal such as steel as I sometimes use, the interior bore should be well polished. As previously shown by me, for example, in my Patent No. 1,904,197, patented April 18, 1933, it will be noted that it is also sometimes advisable to change area of exit end of forming tube for the various purposes described.

The rear section of the forming tube 12 is threaded to the casting which forms the center and sides of the cold chamber 43 and has a snug fit with a sleeve 60 which is preferably integral with the cone 61 which forms the exit cap for the heating chamber cylinder 63, this heating chamber being closed by the forward disk 65 which is integral with the proximate disk 66 of the cooling chamber. The heating chamber 67 receives steam or other medium thru the pipe 68 and discharges thru the pipe 69. The exit end cap 61 is secured in place against the heating cylinder 63 by means of a nut 70 threaded on the exit end of the forming tube 12 and bearing against a washer 71 which compresses the asbestos 73 or other suitable material which is packed between the cone 61 and the sleeve 60, this space and material in the heating chamber for the formed rod, tube or sheet of extruded material makes it unnecessary to have a final cooling chamber.

The operation of my device is as follows: If the machine is to insulate wire the guide tube 14 is held in the position shown and the feed shaft including the worm 40 is revolved by means of power applied to the drive shaft 15. Engagement of the cam 26 which is non-rotatably secured to the feed shaft 10 causes this feed shaft and its worm 40 to reciprocate as well as rotate, such motion being permitted by the feather or splined engagement of the feed shaft 10 with the coupling 18 which is fast on the short section 16. Material is fed thru the opening 46 where it is carried by the worm to the right as seen in Figure 1. The extension of the guide tube 14 beyond the rear of the worm 40 protects the cable or other object to be covered from engagement with the extruded material until it reaches the end of the guide 14.

In order to prevent the building up of pressure between the guide tube 14 and the feed shaft 10 an internal worm 77 is formed preferably integral with the shaft 10 and rather tightly engaging the guide tube 14, this auxiliary worm feeding in the same direction as the feed worm 40 and therefore preventing the packing of material between the guide tube 14 and the interior of the feed shaft 10. The extruded material is solidified by the heat in the chamber 67, the chilling chamber 43 is customary being provided to prevent heat from passing from the chamber 67 to a point in proximity to the worm which might seriously interfere with the operation. As the plunger has to supply total pressure or force especially when it is a screw and is not reciprocating it seems best to speak here in terms of speed and of forming into proper shape, for example; the extruded material is compressed and formed to shape by the tapers 78 and 79 giving proper variation to speed of flow as these cross sectional areas vary, hence entering at the entrance end of the final section of the forming tube 12 in the condition of tension or pressure desired. After passing the point 80 at the forward end of cone 61 heat is no longer received so fast by the extruded material but as this passes thru the forming tube within the cone heat is transferred within the extruded material because the packing of asbestos 73 regulates exchange of heat to the surface of the material so that this chamber may be considered as an annealing chamber or the entire heating chamber a tapered heat conducting chamber causing the heat to be uniform thruout the material. I find that by using this partial heat-insulated chamber I can secure materially better product, because the formed material is relieved of excessive strain within itself for the time rate of exchange of heat within the heating chamber is such as to yield almost uniform temperature from the axis to the peripheral surface of the material irrespective of cross sectional shape. The same effect can be obtained by proper distribution of electrical or other heating units.

When the machine shown in Figure 1 is to form a tube without any core, as, for example, in the making of very fine rubber tubing, I project the guide tube 14 all the way thru the machine as shown by the dotted lines 22 and in this way the extruded material issues as a pipe and forms an insulating material that can be applied to short sections of wire, if desired, or be used as porcelain insulation tubes are now used.

When the machine is used to make shapes of extruded material without a core the guide tube is left out entirely and the screw is made without internal threader worm, and may have in fact no hole. Plunger movements such as illustrated in my cited patent can also be used but I prefer the worm action.

In the modification shown in Figure 5 I have introduced mechanism for turning the guide tube 14 in the same direction as sleeve 16 but at a different speed. This mechanism consists of gear 81 keyed to sleeve 16, and meshing with gear 82 which thru shaft 83 and gear 84 drives the gear 85 keyed to guide tube 14. On the tube 14 is mounted a spider 86 carrying a plurality of spools 87 which spools feed the wire into the end of the tube at 88. The opposite end 90 is preferably internally threaded for receiving a mandrel 91 which is provided with a number of openings 92 out of which the wires 93 are fed into the insulation at about the point 55 within the heating zone. The mandrel 91 is preferably tapered as shown in Figures 6, 7 and 8 or it may be stepped as shown in Figure 9 and is made long enough to extend into the nearly solid portion

at point 94 in order to keep the wires apart until the insulation sets sufficiently to hold them in this separated relation. The taper of the mandrel is provided in order to reduce the friction at this portion or in other words the resistance to the extrusion is almost entirely on the outer crust which has practically solidified as it reaches the point 55. The mandrel may have a central bore 92' in order to feed a core of wire or other material along with the strands 93. See Figure 7.

The reciprocating mechanism illustrated in Figure 5 differs from that in the other modification in that the roller 28 operates in a groove cam 95 whereby the plunger or feed shaft 10 is positively reciprocated independent of the back pressure built up in the forming tube. The grooved cam permits the use of a smooth feed shaft devoid of external worm 40 or internal worm 77. Altho only a single stroke cam, i. e., one feed stroke per revolution of cam, is illustrated in Figure 5, it will be seen that a cam of any desired number of strokes may be used. The operation of the machine in Figure 5 is quite similar to that of Figure 1 and will not be described since the differences will be obvious from a consideration of the drawings and the preceding description.

What I claim is:

1. In an extruding machine, a worm for feeding material into a forming tube, means for driving said worm to feed the material and for at the same time reciprocating said worm to pack said material as it is fed.

2. In an extruding machine, a worm for feeding material into a forming tube, means for turning said worm, and means for reciprocating said worm with strokes proportional in length to the back pressure developed by turning of the worm.

3. In an extruding machine, a forming tube, a hollow shaft coaxial with and extending into the mouth of said tube, a worm on the exterior of the shaft for forcing material into the tube, a core guide within the shaft and extending into the mouth of the tube, and a second worm within the forming tube engaging the core guide.

4. The device of claim 3 in which means are provided for turning said shaft, and means for holding said guide stationary.

5. The device of claim 3 in which means are provided for turning said shaft, means for holding said guide stationary and in which said guide extends beyond the exit of said forming tube.

6. The device of claim 3 in which means are provided for simultaneously turning and reciprocating said shaft.

7. In an extruding machine, a forming tube, a cooling chamber at the mouth of said forming tube, an annular heating chamber around the exit end of the tube, and means within the heating chamber for insulating the extreme end portion of said tube from the heat of the heating chamber.

8. In an extruding machine, a forming tube, an elongated heating chamber surrounding a portion of said tube, means for circulating a heating element thru said chamber, and means at one end of said chamber for insulating a portion of the tube from said heating element.

9. The device of claim 8 in which said insulating means is a relatively massive body of low heat conducting efficiency whereby heat is transferred therethru at a uniform rate substantially independent of heat fluctuations in said chamber.

10. In an extruding machine, a forming tube, an elongated heating chamber surrounding said tube, a body of low heat conducting efficiency secured to one end of and extending within said chamber, said body substantially filling the end of the chamber and converging toward said tube whereby the rate of heat conduction thru said body to the tube is greatest at the converging end and is a minimum at the exit or large end.

11. In an extruding machine, a forming tube, a worm telescoping in said tube, said tube having an opening in the top and one side exposing a portion of said worm, and a resilient member secured to said tube and partially covering said opening but shaped to guide extrusion material into the opening.

12. In an extrusion machine, a forming tube, a guide tube and a feeding plunger all coaxial and said plunger lying within a portion of the forming tube, said guide tube lying within the plunger and extending beyond the same into the forming tube, means for holding said tubes stationary, and means for simultaneously turning and reciprocating said plunger.

13. The device of claim 12 in which the plunger has an internal worm in contact with the guide tube to prevent the building up of pressure due to the packing of material between the guide tube and the plunger.

14. In an extruding machine having a forming tube, means for forming a tapered heating zone in said tube, that is, a zone in which the temperature varies from a maximum at one end to a minimum at the other.

15. In a machine of the class described, a mandrel comprising a guide portion and a tapered end, said guide portion having a central bore and a number of bores radiating from said central bore and sloping toward the tapered end.

16. The device of claim 11 in which said member is an arcuate spring strap secured at one end to the outside of the tube and having its free end doubled back and curved inward to engage the worm at the lower side of the opening.

17. The device of claim 11 in which said opening is rectangular in side elevation and said member is a broad flat leaf spring secured at one end to the bottom of the tube and curved upward to cover the side of said opening, the free end of the spring being doubled back and inward substantially concentric with the tube and having its tip edge engaging the worm whereby material is directed toward said worm.

18. The device of claim 12 in which said last means comprises a pair of coaxial hollow shafts, one of said shafts being connected to a driving wheel and the other shaft being connected to a reciprocating means, said shafts being connected together by means constraining them to turn together but permitting the plunger carrying shaft to reciprocate.

19. In an extruding machine, a forming tube, a shaft coaxial with said tube and having an external worm for feeding material into the tube, means for turning said shaft, a cam member and a cooperating follower member, one of said members being secured to said shaft to turn therewith and the other member being fixed whereby as said shaft is turned it is caused to reciprocate by the interaction of said members.

20. In an extruding machine, a worm for feeding material into a forming tube, a shaft for driving said worm, a bearing for said shaft, said bearing constituting one end of the forming tube, a support for said bearing, a follower on said support positioned adjacent said shaft and adapted to turn on an axis normal to the shaft, a cam

surrounding said shaft and fixed thereto for cooperating with said follower whereby said shaft is reciprocated as it is turned, and means for turning the same.

21. In an extruding machine, a worm for feeding material into a forming tube, means for turning said worm, and means for reciprocating said worm at strokes of a length proportional to the back pressure developed.

22. In an extrusion machine, a forming tube, a guide tube and an externally screw threaded feeding plunger all coaxial and said plunger lying within a portion of the forming tube, said guide tube lying within the plunger and extending beyond the same into the forming tube, means for holding said tubes stationary, and means for simultaneously turning and reciprocating said plunger.

23. The device of claim 22 in which the plunger has an internal worm in contact with the guide tube to prevent the building up of pressure due to the packing of material between the guide tube and the plunger.

24. The device of claim 14 in which the tapered zone is at the exit end of the tube.

25. In an extruding machine, a forming tube, a cooling chamber in heat transfer relation with said tube, a heating chamber in heat transfer relation with said tube and additional heat transfer means associated with said tube for transferring heat thereto at rates varying with the axial location of the heat transfer point along the tube.

26. The device of claim 25 in which said additional means is associated with the heating chamber to receive heat therefrom and to transfer part of said heat to the tube as recited in said claim.

27. In an extruding machine, a forming tube, a guide member within the tube and mounted for axial adjustment with respect to the forming tube whereby the free end of the member may be located at any point along the axis of the tube.

28. In an extrusion machine for forming a multiple conductor cable in which the conductors are spaced from each other by heat reactive insulating material, a forming tube, means for producing congealing zones of different temperatures along the tube, means for forcing unset insulating material into and through said tube, means for guiding a plurality of conductors in spaced relation into the unset but compressed insulation and for holding the conductors in spaced relation while the insulation sets as it moves through the tube, and means for turning said guiding means whereby the conductors are twisted about each other in spaced relation just prior to the setting of the insulation.

29. In an extrusion machine, a forming tube, a guide tube and a tubular feeding plunger all telescopically arranged, said guide tube lying within the plunger and extending therethrough into the forming tube, means within the forming tube and attached to the end of the guide tube for guiding a plurality of conductors into the forming tube in spaced relation, means for feeding a plurality of conductors through said guide tube and means for producing relative rotation between the guide tube and the forming tube.

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