May 6, 1941. D. JUELSS ET AL 2,241,203

APPARATUS FOR MAKING PENCIL LEADS

Filed Nov. 11, 1937 5 Sheets-Sheet 1

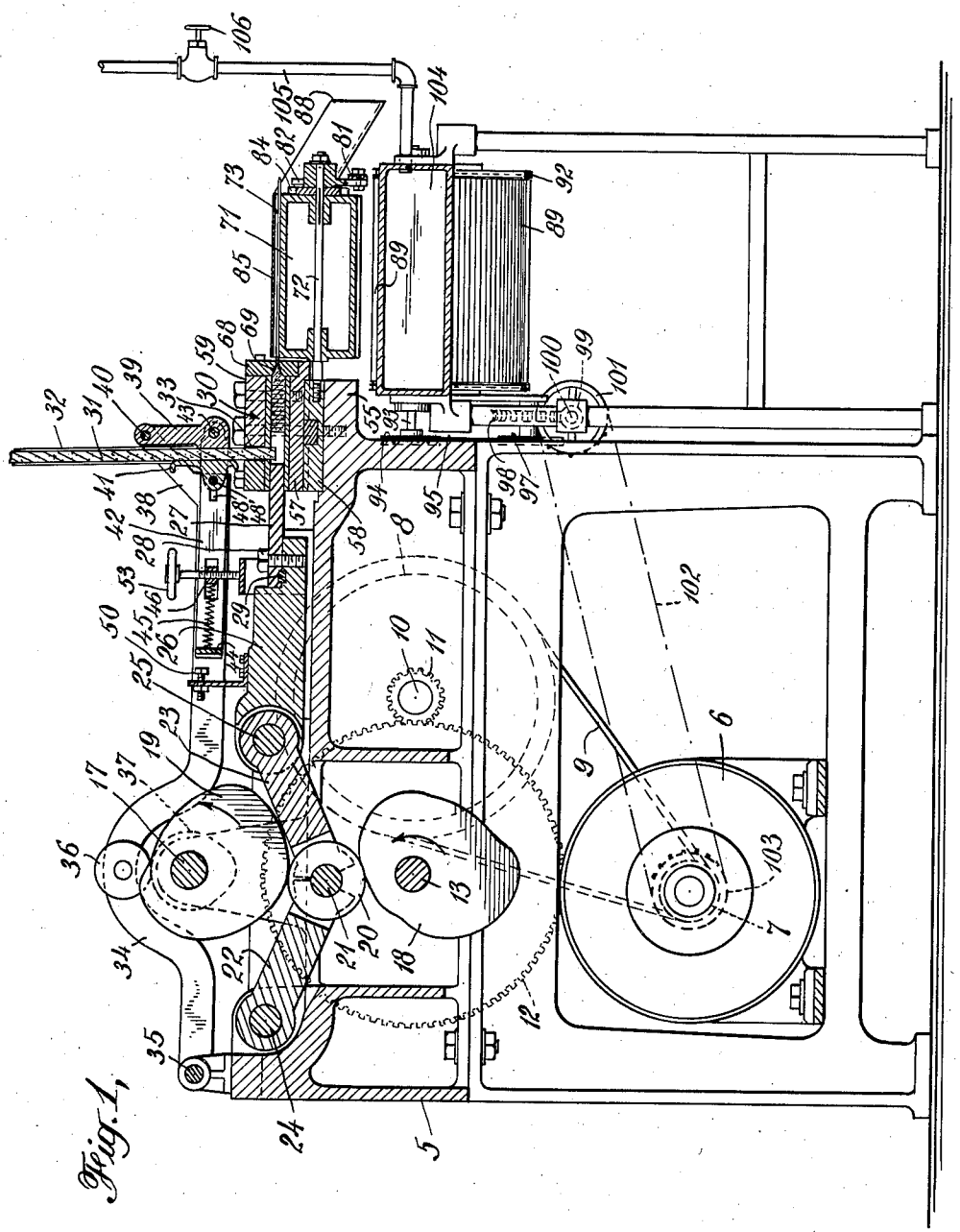

Fig. 1.

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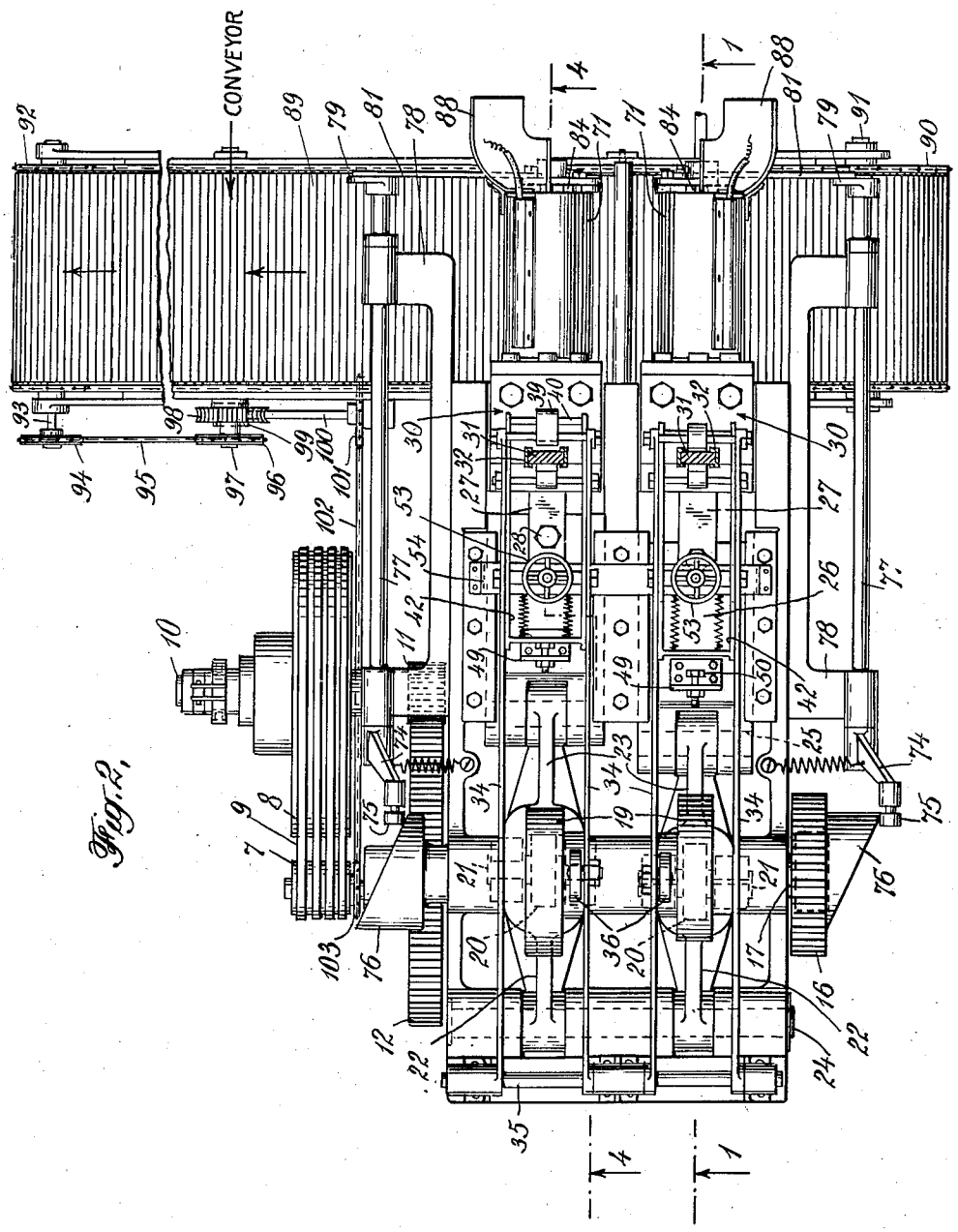

Fig. 2.

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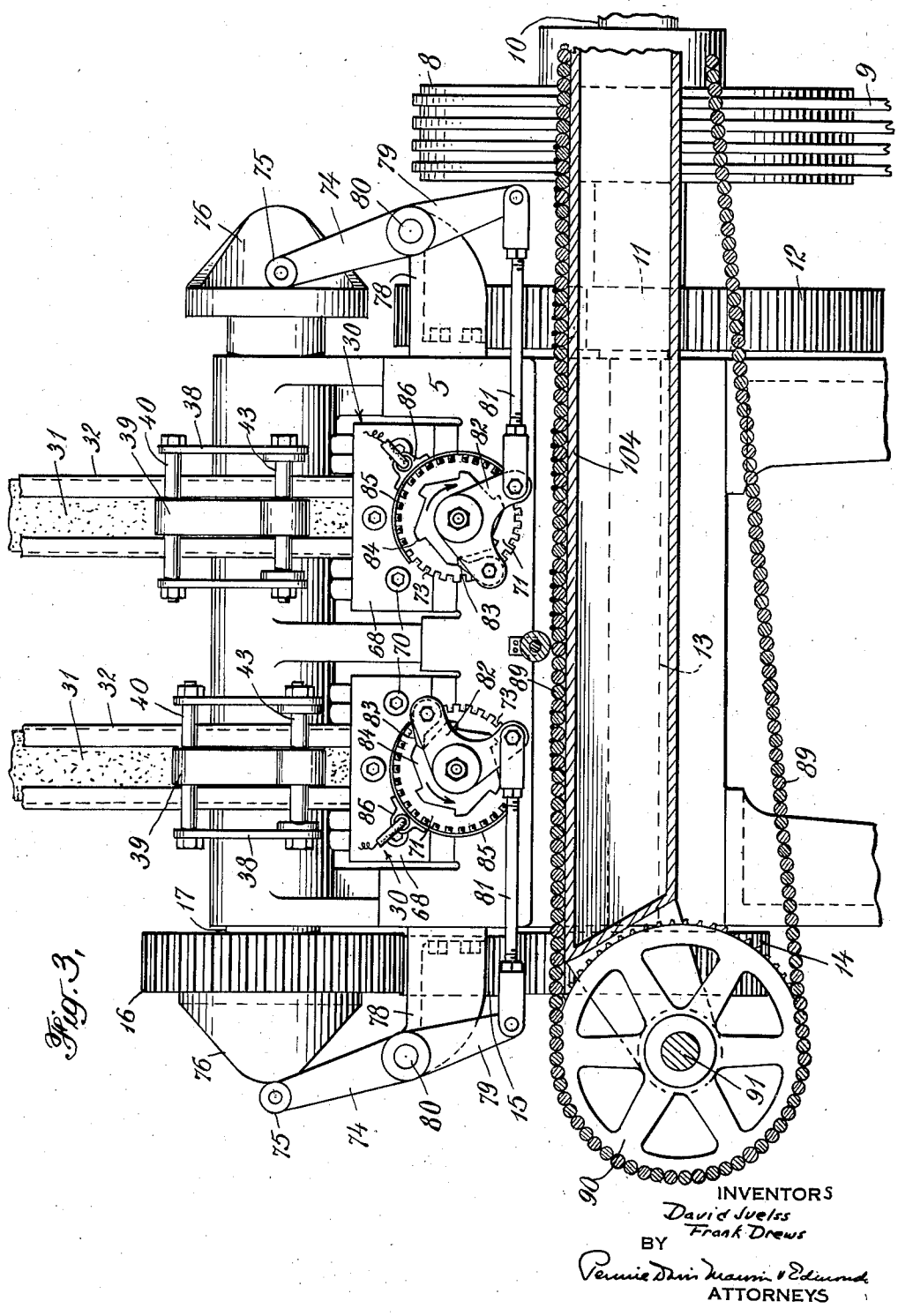

Fig. 3.

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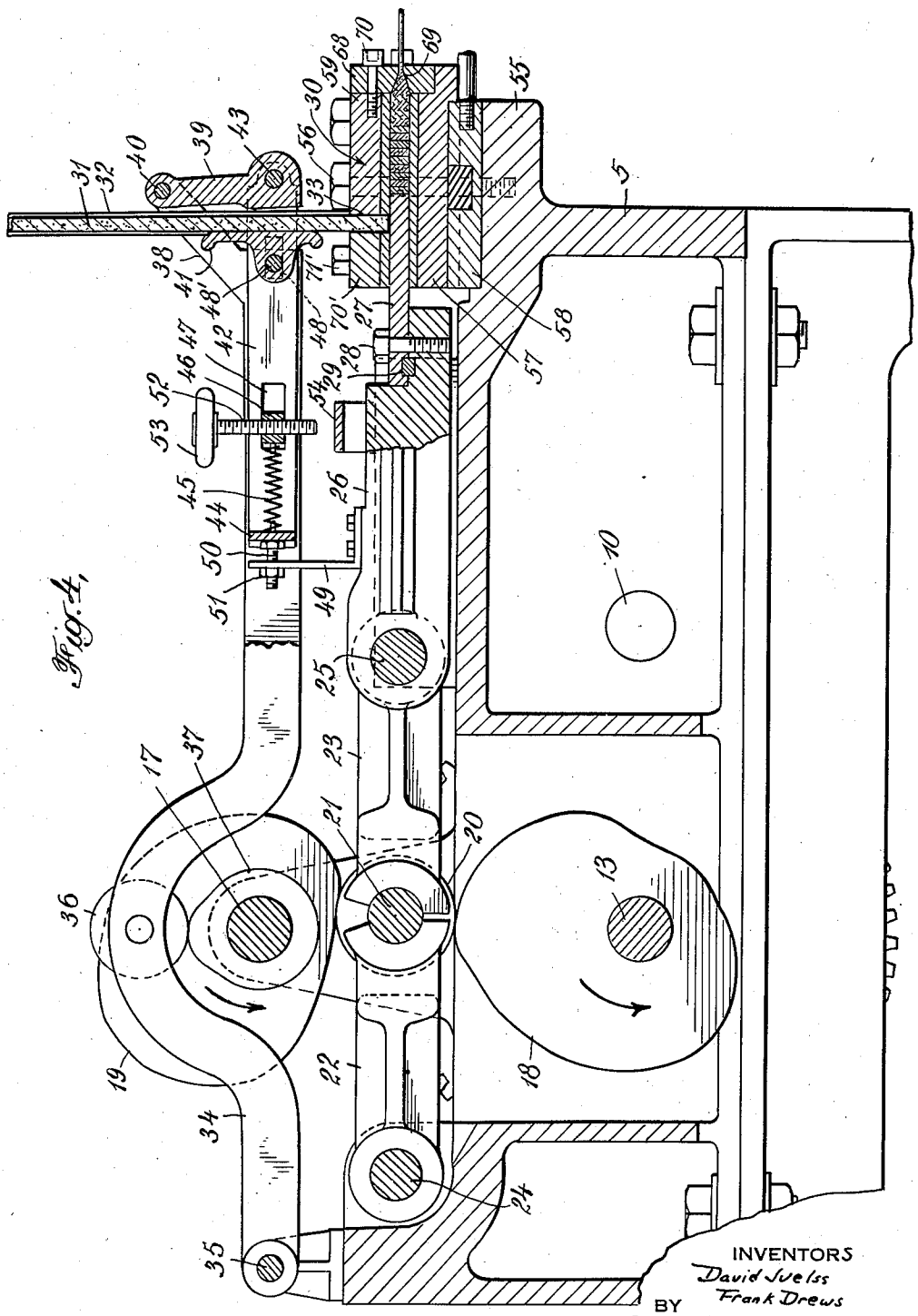

Fig. 4.

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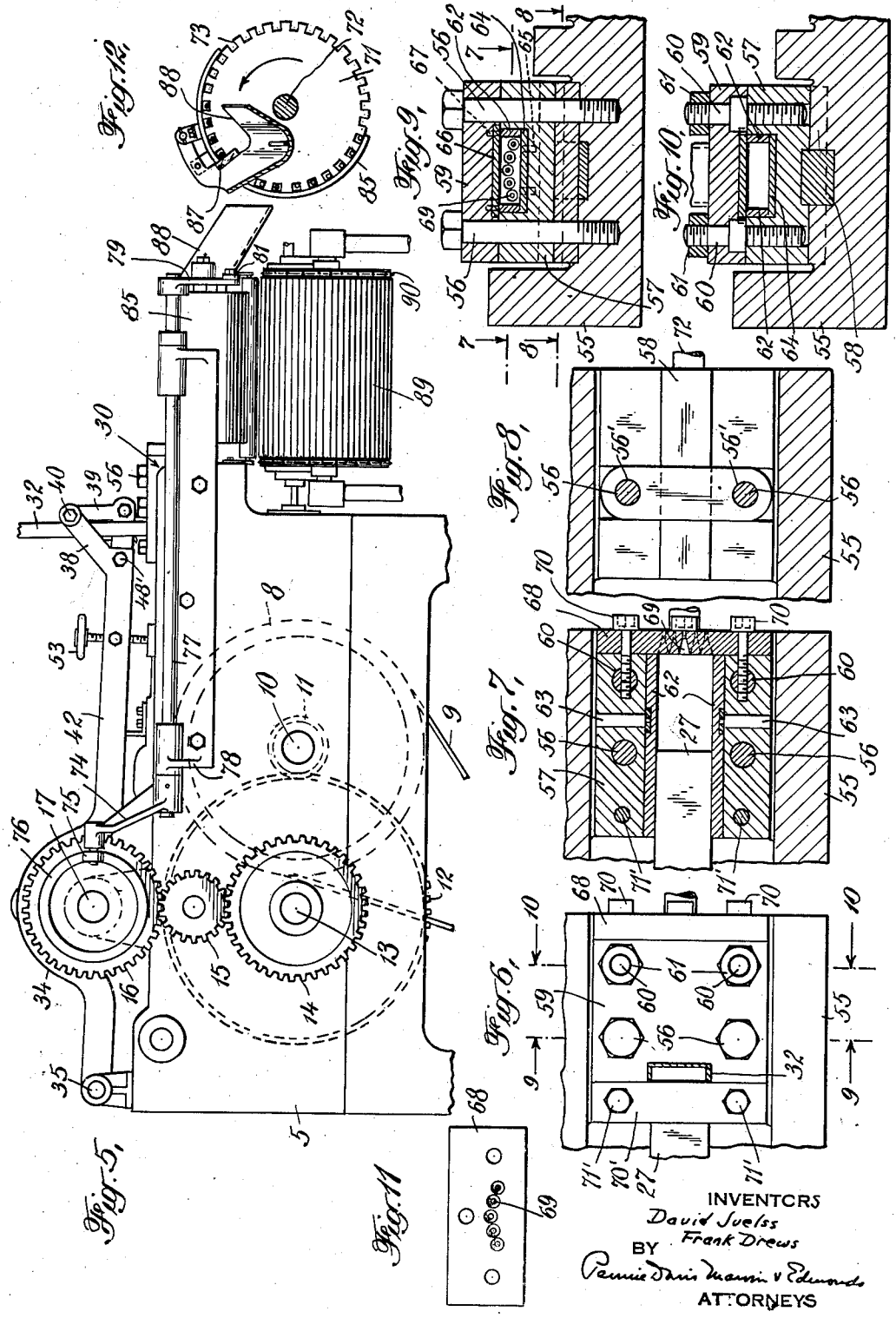

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UNITED STATES PATENT OFFICE

2,241,203

APPARATUS FOR MAKING PENCIL LEADS

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Application November 11, 1937, Serial No. 174,096

6 Claims. (Cl. 18—12)

This invention relates to an apparatus for forming rods from plastic materials, and particularly to improvements adapted to facilitate the manufacture of pencil "leads." Rods of plastic materials other than those employed in pencil leads may be produced similarly and utilized for a variety of purposes to which they may be adapted. For purposes of illustration, the invention will be described more fully in respect to its special application to the manufacture of pencil leads.

In the production of pencil leads, mixtures consisting essentially of finely divided clay and graphite with some water are, after thorough mixing, formed into elongated bodies or ribbons of shape and dimensions approximating those of an ordinary wood lath. These are in turn fed to a machine which periodically severs a portion or pellet from the end of the body and extrudes the material, which is relatively stiff and plastic, through a multiple die to form the leads. The leads are collected as formed, and subjected to a drying operation whereby water is expelled. After drying, the leads are sufficiently hard to permit handling, so that they may be packed in retorts and fired. This method of producing pencil leads, as disclosed in U. S. Letters Patents Nos. 1,362,093, 1,362,094 and 1,362,095 has been in use for many years, although it is not the method commonly employed by pencil manufacturers.

The operation as described produces leads of very satisfactory and more uniform quality than is attainable by other methods in use, but it is nevertheless relatively slow and inefficient. The apparatus as used heretofore, either that described in the patents mentioned or the hydraulic or screw presses commonly used, does not permit sufficient precompression of the material to ensure elimination of occluded air, and consequently the leads are not homogeneous. The presence of occluded air results in non-uniform distribution of wax in the leads when the latter are waxed after they have been fired. The strength and writing quality of the leads is thus impaired. Also, the mechanism is not readily accessible, and stoppage of the operation for any reason sometimes involves long delays before production may be resumed. The cost of production is consequently relatively high.

The present invention avoids the difficulties of the previously known methods and apparatus, and provides leads of improved quality, particularly with respect to homogeneous character of the lead. Such leads may be used advantageously in wood sheaths. The invention is especially useful in preparing leads for mechanical pencils, since they are stronger and more uniform and therefore resist the stress of writing pressure more successfully.

It is the object of the present invention to provide an improved and more efficient mechanism for feeding and extruding plastic material and particularly for impacting the material and removing air therefrom before it is extruded.

A further object of the invention is the provision of apparatus, the essential parts of which are readily accessible, permitting rapid replacement or repair of worn or broken parts, so that loss of time due to shut-downs is minimized.

Another object of the invention is the provision of rods of plastic material and particularly pencil leads which are substantially free from occluded air and homogeneous in character.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and accompanying drawings, in which

Fig. 1 is a longitudinal section through the machine on the line 1—1 of Fig. 2;

Fig. 2 is a plan view of the machine;

Fig. 3 is a front elevation of the machine;

Fig. 4 is an enlarged section on the line 4—4 of Fig. 2;

Fig. 5 is an end view of a portion of the machine;

Fig. 6 is an enlarged plan view of the compression chamber;

Fig. 7 is a section on the line 7—7 of Fig. 9;

Fig. 8 is a section on the line 8—8 of Fig. 9;

Fig. 9 is a section on the line 9—9 of Fig. 6;

Fig. 10 is a section on the line 10—10 of Fig. 6;

Fig. 11 is an elevation of the multiple die; and

Fig. 12 is an end view partially in section of the discharge mechanism of the machine.

In order to secure maximum possible efficiency, the machine embodies two separate compression chambers, each provided with a multiple die and duplicate mechanisms for feeding and applying pressure to the material. The application of pressure is effected from a single source of power, the pressure rams being connected so that pressure is applied alternately in the two compression chambers. Thus, for each rotation of the driving shaft, two compression cycles are completed, and the finished leads are formed in such a manner as to afford a substantially continuous operation. In describing the mechanism, therefore, it will be understood that the various parts are duplicated on the two sides of the machine.

Pressure is applied to the material in a predetermined manner by means of a toggle mechanism actuated positively in both directions by opposed cams designed not only to ensure such positive movement but also to afford rapid movement of the ram during the major portion of the forward and reverse movement thereof, and relatively slow movement during the period while the material in the compression chamber is under the maximum compression. The "dwell" of the ram during the period of maximum compression permits the relatively slow squeezing of the plastic material in the compression chamber as the material is extruded through the die. Furthermore, the compression chamber is designed to hold a relatively large quantity of the plastic material, and the portions thereof which have been introduced and are moving forward in the compression chamber are subjected to a slow squeezing action which substantially eliminates all occluded air. The amount of material maintained in the compression chamber should be at least five and preferably ten to twenty times the amount extruded upon each application of pressure. The air thus expressed escapes rearwardly around the edges of the ram, which has a sufficiently loose fit to permit such elimination. Consequently, the material which approaches the die and is extruded is free from air and is relatively more dense than it would be otherwise, with the result that the extruded lead is of superior quality.

In addition to the features mentioned, the apparatus provides for feeding plastic material positively and in an amount predetermined by adjustment to afford exactly the required quantity for each forward movement of the ram, in order to ensure proper pre-compression and the removal of occluded air. The amount of material thus added at each stroke is such that the first effect of the ram is to squash the pellet and thus to remove immediately a large part of the occluded air. The remainder of the air is separated by the squeezing action as the material is forced forwardly toward the die against the resistance of the preceding material and the back pressure resulting from frictional resistance of the chamber walls.

The compression chamber and die are constructed to afford complete rigidity and wear-resistance, the structure being nevertheless such that it may be readily taken apart so that any worn or broken parts may be removed and replaced with maximum facility.

Referring to the drawings, 5 indicates a rigid frame affording a support for the various parts of the mechanism. A source of power, such as a motor 6, is mounted on the frame and is provided with a pulley 7 which drives a pulley 8 through the belt 9. The pulley 8 is mounted on a transverse shaft 10 carrying a pinion 11, which in turn drives a gear 12 on a transverse shaft 13, suitably supported in the frame 5. The shaft 13 carries a gear 14 meshing with a pinion 15 which in turn engages a gear 16 on a transverse shaft 17, likewise suitably supported in the frame 5.

The shafts 13 and 17 carry opposed cams 18 and 19 which continuously engage a roller 20 on a pivot 21 which connects the links 22 and 23 forming a toggle. The link 22 is pivoted at 24 on the frame 5. The link 23 is connected by a pivot 25 to a sliding member 26 mounted in suitable guideways in the frame 5. A ram 27 is secured by bolts 28 with a key 29 to the sliding member 26. One end of the ram 27 projects into the compression chamber 30. Thus, as shafts 13 and 17 revolve, the cams 18 and 19 shift the toggle and cause the sliding member 26 and the ram 27 to reciprocate. As the toggle is straightened, the ram 27 advances, the cams being so formed that the initial rate of advance is comparatively rapid, followed by a slower movement until the stroke is completed, whereupon the toggle is broken and the ram is withdrawn at a comparatively rapid rate and then commences another forward stroke. As hereinbefore indicated, the mechanism is duplicated on the two sides of the machine, and one of the rams is retracted as the other advances, permitting alternate compression strokes in the two compression chambers.

Plastic material 31, in the form of a ribbon, is supported in a chute 32 and is fed positively through an opening 33 in the top of the compression chamber before the ram 27 advances, so that a predetermined amount of the plastic material is sheared from the ribbon and forced into the compression chamber by the ram. The feeding is effected by a rocker arm 34 pivoted at 35 on the frame 5. A roller 36 on the rocker arm engages a cam 37 on the shaft 17, the cam being shaped and positioned so that the rocker arm 34 is lifted after the ram 27 has advanced sufficiently to support the ribbon 31. At its forward end, the rocker arm 34 has an upwardly projecting arm 38 to which a gripper 39 is pivoted at 40. The face of the gripper is adapted to engage the ribbon 31 during the downward movement of the rocker arm 34, forcing the ribbon against a shoe 41 which is supported on the arm 34, and to release the ribbon 31 as the rocker arm 34 is lifted. The movement of the gripper 39 is effected by a bar 42 pivotally connected at 43 to the gripper 39 and extending rearwardly to afford an abutment 44. A compression spring 45 is disposed between this abutment and a cross-bar 46 which is mounted on the rocker arm 34. The compression spring holds the gripper 39 in position to engage the ribbon 31 except when the spring 45 is compressed. Slots 47 and 48 in the bar 42 permit longitudinal movement thereof, the bar being supported during such movement by the cross-bar 46 and the pin 48'. An arm 49 projects upwardly from the member 26 and is provided with an adjustable screw 50 locked by a nut 51 which is adapted to engage the abutment 44 as the member 26 advances. The screw 50 is adjusted so that when the ram 27 has severed a section or pellet from the ribbon 31 and is in position to support the ribbon, the bar 42 will be moved forwardly against the spring 45, thus disengaging the gripper 39. As the gripper is disengaged, the rocker arm 34 is lifted by the cam 37, and upon the return stroke of the ram 27 the spring 45 forces the gripper 39 into engagement again with the ribbon. The rocker arm 34 then moves downwardly, advancing the ribbon into the compression chamber. The feed is positive, and the amount thereof is regulated by a screw 52 mounted in the cross-bar 46 and provided with a hand wheel 53 to facilitate adjustment. The screw engages an abutment 54 on the frame 5. By adjusting the screw 52, the feed can be regulated to the precise amount required to ensure the most satisfactory product.

As hereinbefore indicated, the compression

chamber is rigidly constructed, but nevertheless is readily accessible, all of its parts being demountable to permit access and removal or replacement of any broken parts. The compression chamber rests upon a shelf 55, forming a part of the frame 5, to which it is secured by bolts 56. The lower block 57 of the compression chamber is held rigidly on the shelf 55 by a key 58, which prevents longitudinal and lateral movement. The bolts 56 extend through openings 56' in the key 58. The upper block 59 is secured to the lower block 57 by bolts 60 and nuts 61 and by the bolts 56. Within these blocks, a compression chamber is formed by plates of hardened and resistant steel of any suitable composition, but preferably one embodying nickel and chromium in its composition, to afford hardness and wear resistance. The side plates 62 are held by pins 63 extending through the supporting structure. The lower plate 64 is similarly held by pins 65, and the upper plate 66 is held by pins 67, so that all of the parts are secured against relative movement and rigidly mounted. The die plate 68, having a plurality of openings 69 in the face thereof, through which the material is extruded, is held against the face of the compression chamber by screws 70 which extend through the bolts 60, thus locking the bolts against movement and increasing the rigidity of the structure. A bar 70' is secured by bolts 71' to the upper block 59 as a guide for the ram 27.

As pressure is applied to the material in the compression chamber, it is extruded through the die openings in the form of a plurality of rods. The stroke is such that the rods as formed are slightly longer than the finished dimensions. To receive and support the rods as formed and while they are still in a plastic condition, a drum 71 is supported on a shaft 72 projecting from the key 58 in front of the die plate 68. The drum is provided with a plurality of grooves 73, and at the moment of extrusion five of these grooves are positioned directly in front of the die opening 69, so that the extruded rods are forced into the grooves. The drum is actuated by a rocker arm 74 having a roller 75 which engages a cam 76 on the shaft 17. The rocker arm 74 is secured to a shaft 77 mounted in a bracket 78 and carries at its end an arm 79 pivoted at 80 on the frame 5 and connected by a link 81 to a bell crank lever 82, loosely mounted on the shaft 72. The bell crank lever carries a pawl 83 which engages a ratchet 84 secured to the shaft 72. The cam 76 is formed so that upon the completion of the stroke of the ram which has forced the rods from the die into the grooves 73 of the drum 71, the pawl 83 is actuated to advance the drum 71 in the direction of the arrow, thus removing the finished product from the die plate. A shield 85 extends part way about the drum, so as to support the rods until they are carried to the point where they may be discharged. An electric heating element 86 is connected to the shield 85 and adapted to be supplied with current from a source of power so that the shield is heated by conduction and the temperature is raised to prevent condensation of moisture and possible sticking of the extruded rods in the grooves 73.

As indicated, the rods as formed are slightly longer and project from the grooves at the front of the drum 71. To remove the projections, a knife 87 is supported on the shield 85 with its edge bearing against the face of the drum 71. As the drum rotates, the ends of the rods are sheared flush with the face of the drum, and the parts removed are discharged through a chute 88.

As the rods in the grooves 73 reach the lower edge of the shield 85, they drop, one by one, upon a conveyor consisting of a series of rollers 89 connected by links at their ends to form a continuous conveyor which passes at one end over a sprocket 90 supported on a shaft 91, and at the other end over a similar sprocket 92 supported on a shaft 93. The shaft 93 carries a sprocket 94 which is connected by a chain 95 to a sprocket 96 on a shaft 97. A worm gear 98 on the shaft 97 is driven by a worm 99 on a shaft 100. The shaft 100 carries a sprocket 101 and is driven by a chain 102 from a sprocket 103 on the drive shaft of the motor 6. The movement of the rollers 89 forming the conveyor is timed with respect to the rotation of the drum 71, so that as each rod falls from the drum 71 it is between two adjacent rollers 89 and is conveyed thence to the discharge end of the conveyor.

A chamber 104, which is supplied with any suitable heating medium, preferably steam, through a pipe 105 having a valve 106, is disposed beneath the upper flight of the conveyor, and supplies heat to the conveyor and to the rods disposed thereon, so as to continue the removal of moisture from the rods as they are advanced. From the rollers 89, the rods may be discharged upon any other suitable mechanism to continue the drying operation until the rods are sufficiently stiff to permit handling thereof.

In describing the operation of discharging the rods from the die plate, I have referred to the elements of a single mechanism for that purpose, but as already pointed out, the mechanism is duplicated so that the rods formed by the alternate compressions in the two compression chambers are similarly delivered to the rollers 89 forming the conveyor. The operation of the conveyor is timed with respect to the discharge of the rods, so that rods formed and delivered at the two sides of the machine fall upon the conveyor in such a way as not to interfere.

Because of the utilization of power through the application of pressure in alternate pressure chambers during rotation of the drive shaft, the operation is speeded up and the output of the machine is markedly increased. A very important advantage results from the method of feeding the material positively and in predetermined amounts, and in maintaining within the compression chamber a relatively large quantity of the material which is subjected repeatedly to pressure, thereby removing occluded air before the material approaches the die openings. The resulting homogeneity of the product is particularly noticeable. The application of the toggle and the positive operation thereof permits control of the movement and particularly the application of pressure which is maintained for a sufficient period to thoroughly compress the material, thereby facilitating the removal of air. The inclusion in the die chamber of a considerable amount of material increases the back pressure, due to frictional resistance of the chamber walls, which is overcome by the controlled application of pressure through the toggle mechanism. These and other advantages result in substantial improvement of the operation and reduction of the cost of producing rods of plastic material adapted for use as pencil leads and for numerous other purposes.

Various changes may be made in the form, construction and arrangement of the parts, as well

as the details of the operation as described, without departing from the invention or sacrificing any of its advantages.

We claim:

1. An apparatus for forming rods from plastic material comprising a compression chamber having an extrusion orifice, a ram reciprocably mounted in the chamber and means for actuating the ram including toggle means and cams at opposite sides of the toggle means and directly bearing on the knee thereof for positively actuating the toggle means to reciprocate the ram, and means for rotating the cams.

2. An apparatus for forming rods from plastic material comprising a compression chamber having an extrusion orifice, a ram reciprocably mounted in the chamber and means for actuating the ram including toggle means and cams at opposite sides of the toggle means and directly bearing on the knee thereof for positively actuating the toggle means to reciprocate the ram, and means for rotating the cams at a uniform speed, the shape of the cams being such that the initial rate of advance of the ram is comparatively rapid and the later rate of advance is slower.

3. An apparatus for forming rods from plastic materials comprising a pair of substantially parallel compression chambers each having an extrusion orifice, a ram reciprocably mounted in each of said chambers, means for positively actuating the rams so that one advances as the other is retracted, including toggle means and cams at opposite sides of the toggle means and directly bearing on the knees thereof, and means for rotating the cams.

4. An apparatus for forming rods from plastic material comprising a compression chamber having an extrusion orifice, a ram reciprocably mounted in the chamber and means for actuating the ram including toggle means comprising a pair of toggle arms, a pivot pin connecting said arms and a roller mounted on said pivot pin and cams at opposite sides of the toggle means and directly bearing on said roller for positively actuating the toggle means to reciprocate the ram, and means for rotating the cams.

5. An apparatus for forming rods from plastic material comprising a compression chamber having an opening through which a ribbon of plastic material may be fed and an extrusion orifice, a ram reciprocably mounted in the chamber, means for reciprocating the ram, mechanical means for gripping the opposite sides of a ribbon of plastic material for feeding it to and through said opening and into said compression chamber including parts spaced opposite one another, means for causing one of said parts intermittently to move toward the other part to grip the ribbon of material, said parts thereafter moving said ribbon of material towards said compression chamber, means for causing said parts to release said ribbon of material after a predetermined movement toward the compression chamber and means for restoring said parts to their original position to again grip the ribbon of material on a subsequent feeding operation, and means so synchronizing the operation of said feeding means and the operating means therefor with the reciprocation of said ram that the feeding means is operated to feed material to said chamber only between compression strokes of the ram.

6. An apparatus for forming rods from plastic material comprising a compression chamber having an opening through which a ribbon of plastic material may be fed and an extrusion orifice, a ram reciprocably mounted in the chamber and means for reciprocating the ram including toggle means and cams at opposite sides of the toggle means and directly bearing on the knee thereof for positively actuating the toggle means to advance and retract the ram; means for rotating the cams; mechanical means for gripping the opposite sides of a ribbon of plastic material for feeding it to and through said opening and into said compression chamber including parts spaced opposite one another, means for causing one of said parts intermittently to move toward the other part to grip the ribbon of material, said parts thereafter moving said ribbon of material towards said compression chamber, means for causing said parts to release said ribbon of material after a predetermined movement toward the compression chamber and means for restoring said parts to their original position to again grip the ribbon of material on a subsequent feeding operation, and means so synchronizing the operation of said feeding means and the operating means therefor with the reciprocation of said ram that the feeding means is operated to feed material to said chamber only between compression strokes of the ram.

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