April 18, 1933. F. L. DAVIS, JR 1,904,419

LEAD EXTRUSION APPARATUS

Filed June 4, 1932 3 Sheets-Sheet 1

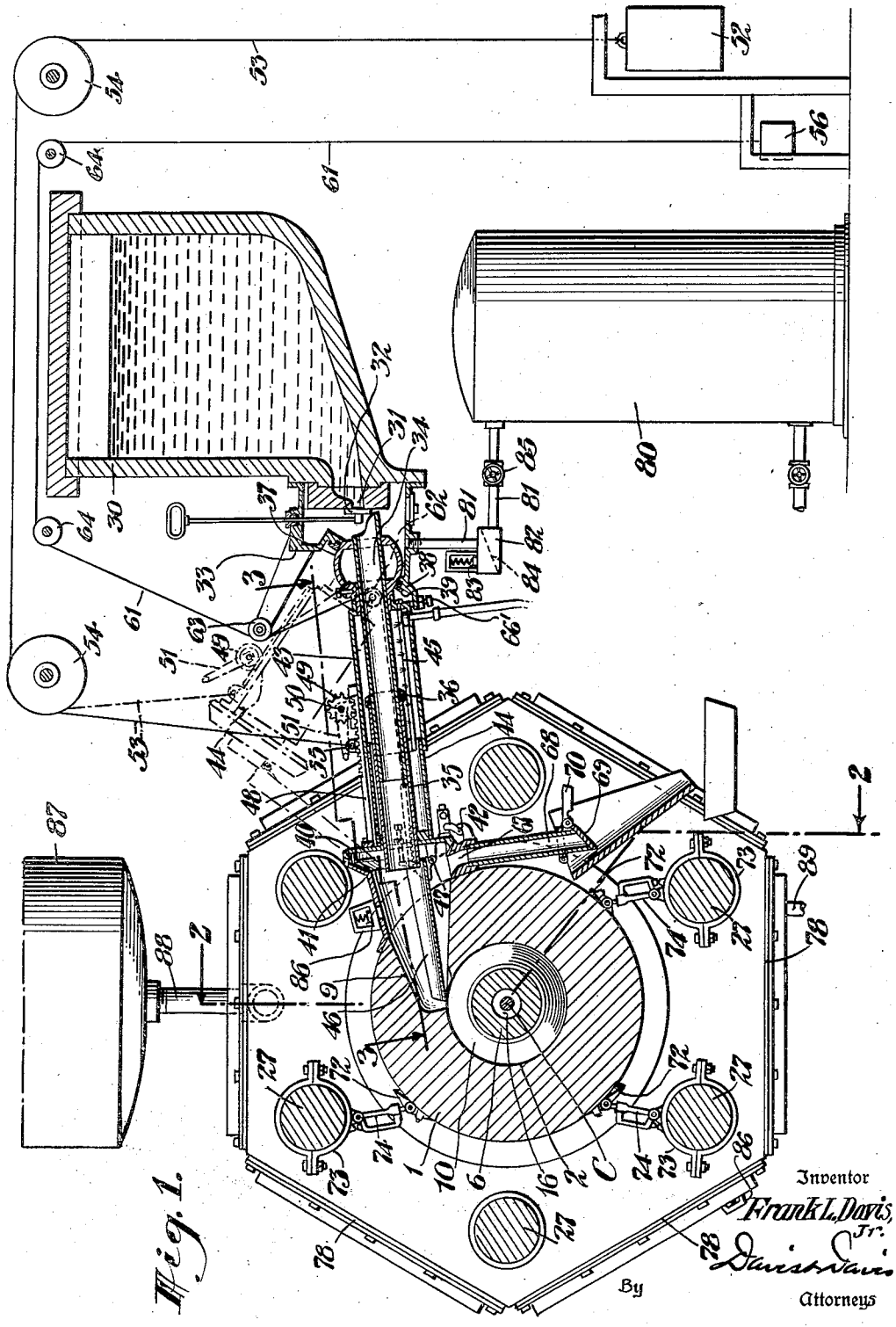


Fig. 1.

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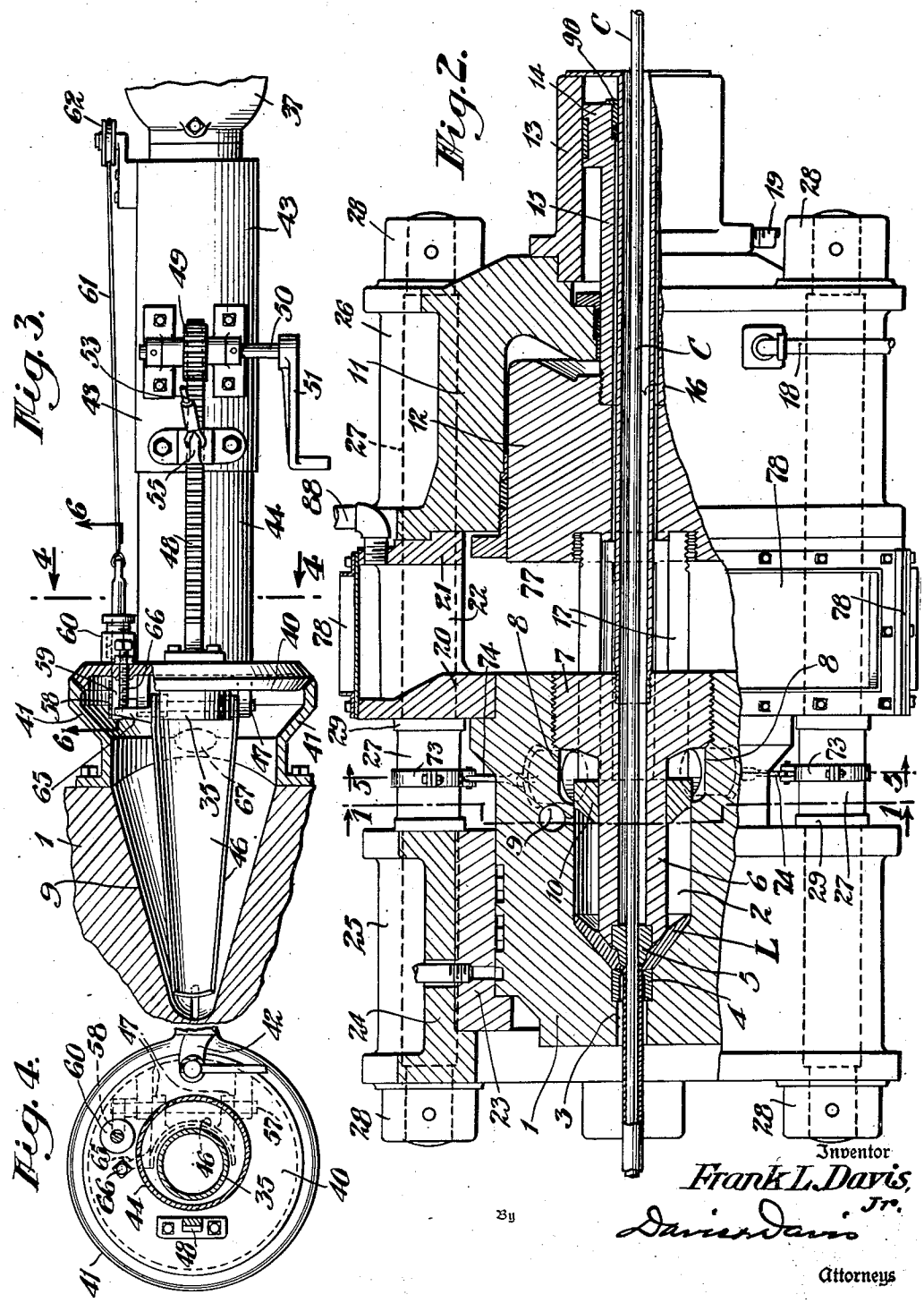


Fig. 2.

Fig. 3.

Fig. 4.

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Fig. 6.

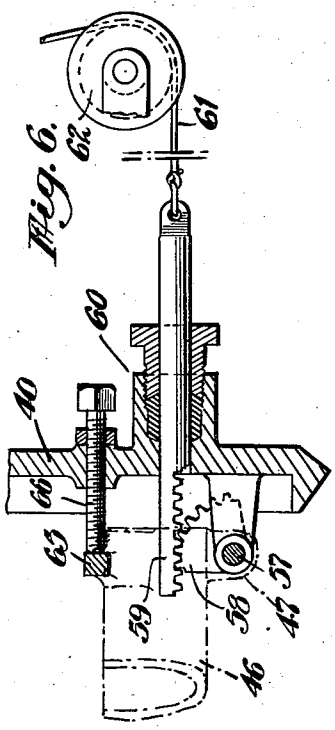
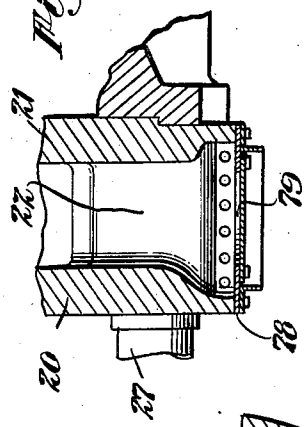


Fig. 7.



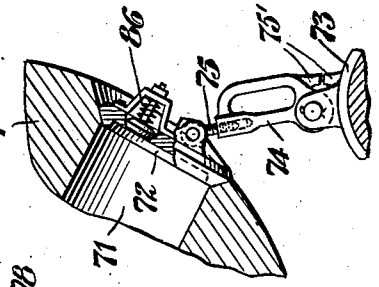


Fig. 8.

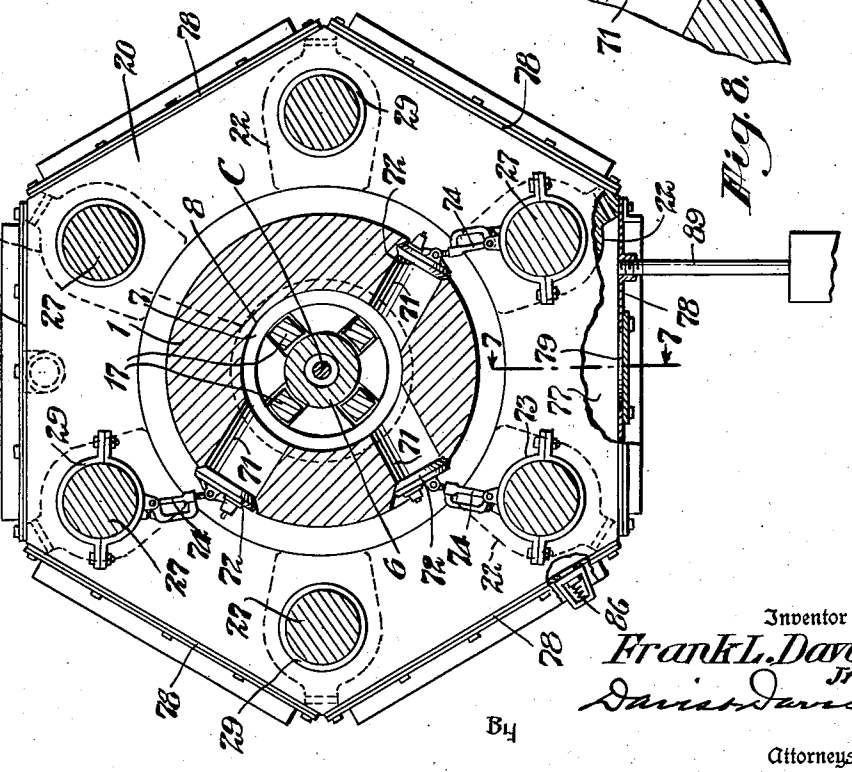


Fig. 5.

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UNITED STATES PATENT OFFICE

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LEAD EXTRUSION APPARATUS

Application filed June 4, 1932. Serial No. 615,332.

This invention relates more particularly to the extrusion of lead to form a sheathing for an electric cable.

An important object of the invention is to provide, in an extrusion apparatus of a certain type, means to effectually exclude air from the extrusion metal from the time it leaves a supply source in a molten state until it is extruded, and thereby prevent oxidation of the metal and consequent flaws in the cable sheathing.

Another important object of the invention is to provide means to afford ready access to the spaces in the apparatus from which air is excluded.

Other objects of the invention will appear hereinafter.

In the drawings, Fig. 1 is a view showing the extrusion press in transverse section and the metal pouring means in longitudinal section, the view being on the line 1—1 of Fig. 2;

Fig. 2 a section approximately on the line 2—2 of Fig. 1;

Fig. 3 an enlarged section approximately on the line 3—3 of Fig. 1;

Fig. 4 a section on the line 4—4 of Fig. 3;

Fig. 5 a section on the line 5—5 of Fig. 2;

Fig. 6 an enlarged detail section on the line 6—6 of Fig. 3;

Fig. 7 an enlarged detail section on the line 7—7 of Fig. 5; and

Fig. 8 a detail sectional view showing one of the cleaning out openings and its closure means.

The invention is shown in connection with a form of extrusion press known as a "straight through" press wherein the extrusion chamber and the extrusion ram surround the cable to be sheathed and the ram operates longitudinally of the cable. This press includes an extrusion unit or head and a hydraulic pressure mechanism disposed in tandem relation longitudinally of the cable and anchored together in fixed spaced relation by tie bolts.

The extrusion head of the press includes a cylindrical block 1 having a central bore 2 to form the extrusion chamber. At one end said bore is tapered and opens into a reduced cable passage 3. In the latter is fitted the annular extrusion die 4 and opposed to the die is the extrusion point 5. The space between the point and die determines the thickness of the cable sheathing. A tubular point holder 6 supports the extrusion point and has a threaded plug end 7 screwed into the cylinder. Adjacent said plug the bore 2 is enlarged, as at 8. A charging passage 9, formed in the cylinder, extends transversely approximately tangential to the upper side of the bore 2 and has a restricted communication with the bore. Within the bore is an annular extrusion ram 10 snugly fitting both the bore and the point holder 6 and reciprocable therealong.

The hydraulic pressure mechanism includes a hydraulic cylinder 11 and a piston 12 mounted to reciprocate therein. Secured to the outer end of the cylinder 11 is a smaller cylinder 13 having a pull-back piston 14 reciprocable therein. A tubular stem 15 connects the pistons 12 and 14 and alines with a central bore in the piston 11. Extending through said stem and passage is a tube 16 which is connected at its inner end to the tubular point holder 6 and combines therewith to form a conduit for the cable C to be sheathed. The ram 10 has legs 17 extending through apertures in the plug end of the point holder and in threaded connection with the hydraulic piston 12. By admission of hydraulic pressure through a pipe 18 to the cylinder 11, the piston 12 is shifted to force the ram on its extrusion stroke and by admission of pressure through a pipe 19 to the cylinder 13 the pull-back piston 14 is shifted outward to retract the piston 12 and the ram.

Between the extrusion cylinder 1 and the hydraulic cylinder 11 there is an annular spacing structure formed of a single casting and comprising hexagonal rings 20 and 21 abutting the cylinders 1 and 11 respectively, and connected by spacing sleeves 22 spaced therearound. A ring 23 encircles the cylinder 1 and has a shoulder abutting the outer end thereof and a ring 24 encircles the ring 23 and has a shoulder abutting the outer end of ring 23. Sleeves 25 integrally formed on

the ring 24 aline with the spacing sleeves 22, and sleeves 26 integrally formed on the hydraulic cylinder 11 aline with the sleeves 22 and 25. Through all of said alining sleeves are passed heavy stay rods or bolts 27 threaded at their opposite ends and having nuts 28 screwed thereon. These bolts anchor together the extrusion head and the hydraulic mechanism. They have shoulders 29 abutting the rings 20 and 24. For operation the press will be supported in a position with its cable conduit either horizontal or slightly inclined.

A covered hopper 30 serves as a container for molten lead. The representation of this hopper is diagrammatic. In practice it will have heating means for fusing the lead and means for charging it with pig lead. I have provided means for delivering molten lead from the hopper to the charging passage 9 of the extrusion cylinder without exposure to air. At its lower end the hopper has a discharge port 31 which may be opened and closed by a slide valve 32. A casing 33 fixed to the hopper forms an airtight chest enclosing said valve and port. An airtight conduit leads from said chest. The conduit includes telescoping tubular sections 34 and 35 with suitable packing 36 therebetween. Between the conduit section 34 and the chest there is an airtight hinge connection including a spherical member 37 fixed to one end of the conduit section and rotatably fitted in an annular seat 38 formed on the chest and provided with suitable packing means 39. Fixed to the outer end of the conduit section 35 is a closure disk 40 to close the charging passage 9. Secured to the extrusion cylinder 1 is an annular casing 41 surrounding the mouth of the passage 9 and forming an extension of the passage. Said casing has a beveled outer edge bearing a gasket, and the closure disk 40 has a beveled edge to fit against said gasket and form an airtight juncture. A suitable releasable clamping device 42 serves to hold the closure disk tightly seated.

A tubular casing surrounds the tubular conduit and is also formed of telescoping sections 43 and 44 fixed respectively to the conduit sections 34 and 35. This outer casing defines a space surrounding the conduit and in said space is suitable means to heat the conduit. In the present instance the heating means comprises a gas burner 45.

The conduit section 35 has an extension spout 46 leading from the delivery end thereof and extending inward through the charging passage 9 to the restricted discharge port of the passage. Between the spout and the conduit there is a hinge connection 47. When the closure 40 is released from its seat the conduit may be telescoped to retract it and may be swung upward out of alinement with the passage 9 to give access to the latter. The hinge 47 permits flexure between the conduit and the spout so that the conduit may be swung upward without full withdrawal of the spout from the casing 41 which forms part of the passage 9. For telescoping the conduit there is a gear rack 48 fixed at one end to the closure 40, and a gear 49 meshing with the rack. The gear is fixed to a shaft 50 mounted in bearings fixed to the outer casing section 43 and a crank 51 is fixed to said shaft for turning it.

For swinging the conduit upward there is a weight 52 attached to one end of a tension strand 53, trained over elevated pulleys 54 and attached, as at 55, to the casing section 43. There is also a smaller weight 56 to restore and hold the extension spout 46 in extended position when the conduit is swung down to operative position. The hinge 47 of the spout includes a pintle 57 to which is fixed a toothed segment 58. A rack 59 meshes with said segment and has a stem extending outward and slidably fitted in a stuffing box 60 on the closure 40. Attached to the stem is a tension strand 61 trained longitudinally of the conduit, around a pulley 62 mounted on the casing section 43, upward around a pulley 63 and over pulleys 64 and downward and attached to the weight 56. A stop finger 65 on the extension spout is engageable with an adjustable stop screw 66 on the closure 40 to limit the swing of the spout under the pull of the weight 56.

When the conduit is to be swung upward the clamping device 42 is released and the crank 51 is turned to shorten the conduit, retract the closure 40 and partly withdraw the extension spout. The weight 52 acts to elevate the released conduit and the free end of the spout engages the interior of the casing 41 and causes flexure between the spout and conduit, as indicated in Fig. 1 by dot and dash lines. Shortening of the conduit by rotation of the crank 51 permits the weight 56 to drop to its lowermost position and rest upon a support. Then as the conduit is swung upward the tension on the strand 61 is relieved by movement of the pulley 62 toward the pulley 63. This permits the spout to flex without resistance by the weight. When the conduit and spout are elevated, access to the passage 9 for cleaning is unobstructed. As the conduit is swung downward tension is re-applied to the strand 61, the spout is guided back into the passage 9 by engagement with the casing 41, and the weight 56 restores the spout to extended position. The downward swing of the conduit is limited by a screw stop 66′ mounted on an extension of the chest 38. By rotation of the crank 51 the closure 40 is re-seated and the spout 46 is thrust inward to its proper delivery position.

The lower side of the charging passage 9 slopes outward to an overflow port 67 at the

under side of casing 41. A tubular discharge spout 68 leads downward from said port and has its lower end closed by a flap valve 69. The latter has a weight 70 to hold it closed. The spout delivers to a trough leading to a pig mold. An overflow of the lead charge forces the flap valve open.

In the operation of the press, lead shavings are often forced past the ram 10 and accumulate in the enlarged portion 8 of the bore 2. For cleaning out this space the cylinder 1 is formed with a number of approximately radial cleaning out openings 71. In the present instance there are three of these openings, two leading downward and one upward. For each opening there is a beveled closure disk 72 seated in a beveled seat at the periphery of the cylinder. Each closure 72 is held seated by a toggle device. The latter includes a split ring 73 encircling one of the tie bolts 27 and rotatable thereon. A link 74 is pivoted at one end to said ring and at its opposite end to the closure and provided with a handle. The pivotal connection between the link and closure includes a threaded shank 75 screwed into a threaded bore in the link and providing for proper adjustment between pivot centers in the assembly of the toggle device. When the toggle is almost on dead center it holds the closure seated and airtight. The closure is quickly unseated and swung open by grasping the handle and breaking the toggle. Stops 75′ on the link 74 and on the ring 73 prevent the toggle from being shifted past dead center.

In order to prevent air leakage inward through the apertures in the plug end of the point holder 6, past the ram and into the extrusion chamber, the space 77 between the rings 20 and 21 of the annular spacing structure is enclosed by panels 78 screw fastened to said annular structure. The lowermost panel has a cleaning out aperture 79 closed by a screw fastened plate.

After each extrusion operation there is a residue of the lead left in the outer end of the extrusion chamber and sealing it. There is then a continuous airtight space including the valve chest 33, the tubular conduit, the charging passage 9, the extrusion chamber 2 and the enclosed space 77 in the annular spacing structure. Means are provided for charging this space with a non-oxidizing gas from a suitable source diagrammatically represented in the drawing by a tank 80. I prefer to employ pure, or approximately pure, nitrogen gas which is non-oxidizing and non-combustible and will not be injurious to the workmen if it escapes. From the tank a supply pipe 81 leads to the valve chest 33. This pipe is formed in two sections joined by a chest 82. The latter has a spring seated blow-off valve 83 and a screen 84 separating the pipe sections in the chest. If combustible impurities are introduced by the gas and become ignited by the heat in the apparatus the screen will serve to prevent the combustion from reaching the supply tank. A manually operable valve 85 in the pipe 81 serves for controlling the gas delivery.

In the operation of the apparatus the air is first evacuated therefrom by opening the valve 85 and admitting the gas, at a materially higher pressure than the atmosphere, to the chest 33. Thence it flows through the lead delivery conduit, through the charging passage 9, into the extrusion chamber 2 and into the space 77 within the annular spacing structure by way of clearances around the ram and also between the ram legs 17 and the apertures in the point holder through which the legs pass. If the outer end of the extrusion chamber is sealed by a residue of lead the air will be expelled through the overflow spout 68, the pressure of the gas being sufficient to force open the weighted flap valve 69. Preferably spring seated blow-off valves 86 are also provided on the casing 41, on the cleaning out closures 72 and on one of the panels 78 to permit the air to escape. The valve 85 is kept open and the gas charge is kept at a pressure exceeding that of the atmosphere to prevent leakage of air into the apparatus. If required, suitable means may be employed to keep the gas at just the proper pressure.

When the apparatus is thus charged with the non-oxidizing gas the valve 32 is operated through a handle extending outside of the valve chest to admit a charge of molten lead from the hopper to the delivery conduit to charge the extrusion chamber through the passage 9. When the chamber is overcharged the excess lead flows out through the charging passage and through the over-flow spout 68. When the discharge occurs the valve 32 is closed. The charge of lead in the extrusion chamber is permitted to cool to the proper plastic consistency for extrusion, then the hydraulic pressure mechanism is operated to force the ram on its extrusion stroke.

From the time each charge of lead leaves the hopper until it is extruded, air is effectually excluded from it by the airtight construction and by the gas under pressure, and oxidation of the lead is prevented. When, as in previous structures, the hot lead is exposed to air in an open delivery spout and in the extrusion chamber it oxidizes rapidly and causes flaws in the cable sheathing which often permit leakage of electric current. My improved apparatus enables an extrusion press of the "straight through" type to produce a strong, uniform, homogeneous cable sheathing free from the flaws of oxidation. It also enables the airtight spaces to be readily opened for frequent

cleaning to remove lead deposits, as previously described. While the invention is particularly useful in cable covering, its structural features may be employed to great advantage in other extrusion processes.

Since the gas-filled space 77 within the annular spacing structure is exposed to the hydraulic piston 12 the volume of said space and consequently the pressure of the gas therein will vary with the different positions of said piston. In order to augment the volume of said space and reduce the variation in gas pressure a tank 87 may be connected with said space through a pipe 88. Said space also has a drain pipe 89 leading to a trap. To prevent leakage of gas from the space 77 and leakage of air thereto along the tube 16 the pull-back piston 14 is provided with a stuffing box 90 fitting around the tube.

Features of invention disclosed but not claimed in this application are claimed in my co-pending application Serial No. 609,818 filed May 7, 1932.

What I claim is:

1. In a metal extrusion apparatus including an extrusion chamber having an airtight charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said supply discharge port to said discharging passage and comprising telescoping tubular sections; means excluding air from said discharge port and the adjacent end of said conduit; an airtight releasable juncture between said conduit and said charging passage, the conduit being retractible from the passage by telescoping; a hinge mounting for the conduit adapting it to be swung out of alinement with the charging passage; and means to automatically swing the conduit out of alinement with the charging passage when it is freed from the latter.

2. In a metal extrusion apparatus including an extrusion chamber having an airtight charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said supply discharge port to said charging passage and comprising telescoping tubular sections; means excluding air from said discharge port and the adjacent end of said conduit; an airtight releasable juncture between said conduit and said charging passage, the conduit being retractible from the passage by telescoping; a hinge mounting for the conduit adapting it to be swung out of alinement with the charging passage; and means to charge said conduit, charging passage and extrusion chamber with a non-oxidizing gas.

3. In a metal extrusion apparatus including an extrusion chamber having an airtight charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said supply discharge port to said charging passage and comprising telescoping tubular sections; means excluding air from said discharge port and the adjacent end of said conduit; an airtight releasable juncture between said conduit and said charging passage, the conduit being retractible from the passage by telescoping; and a hinge mounting for the conduit adapting it to be swung out of alinement with the charging passage.

4. In a metal extrusion apparatus including an extrusion chamber having a charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said discharge port to said charging passage and comprising telescoping tubular sections; an air-excluding chest surrounding said discharge port; an air-tight hinge connection between the adjacent end of the conduit and said chest adapting the conduit to swing vertically; an airtight releasable juncture between the opposite end of the conduit and said charging passage; an extension spout hinged to the conduit and extending through said charging passage; rack and pinion means carried by the conduit and operable to telescope the conduit to retract the latter from the charging passage; a weight operatively connected to the conduit to swing it upward out of alinement with the charging passage, the hinge connection between the conduit and extension spout permitting said upward swing of the conduit without full withdrawal of the spout; and a weight operatively connected to the extension spout to swing the latter about its hinge to operative position when the conduit is restored to operative position.

5. In a metal extrusion apparatus including an extrusion chamber having a charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said discharge port to said charging passage and comprising telescoping tubular sections; an air-excluding chest surrounding said discharge port; an air-tight hinge connection between the adjacent end of the conduit and said chest adapting the conduit to swing vertically; an airtight releasable juncture between the opposite end of the conduit and said charging passage; an extension spout hinged to the conduit and extending through said charging passage; rack and pinion means carried by the conduit and operable to telescope the con-

duit to retract the latter from the charging passage; a weight operatively connected to the conduit to swing it upward out of alinement with the charging passage, the hinge connection between the conduit and extension spout permitting said upward swing of the conduit without full withdrawal of the spout; a weight operatively connected to the extension spout to swing the latter about its hinge to operative position when the conduit is restored to operative position; and means to charge said chest, conduit, charging passage and extrusion chamber with a non-oxidizing gas.

6. In a metal extrusion apparatus including an extrusion chamber having a charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said discharge port to said charging passage and comprising telescoping tubular sections; an air excluding chest surrounding said discharge port; an air-tight hinge connection between the adjacent end of the conduit and said chest; an airtight releasable juncture between the opposite end of the conduit and said charging passage; and an extension spout hinged to the conduit and extending through said charging passage, the conduit being longitudinally contractible by telescoping to retract it from the charging passage and its hinge connections with the chest and with the extension spout adapting it to be swung out of alinement with the charging passage without full withdrawal of the extension spout.

7. In a metal extrusion apparatus including an extrusion chamber having an airtight charging and cleaning out passage and an extrusion ram mounted to reciprocate in the extrusion chamber, an airtight delivery conduit leading to said charging passage and comprising telescoping tubular sections; an airtight releasable juncture between said conduit and charging passage; an extension spout hinged to the conduit and extending inward through the charging passage, the conduit being retractible from the passage by telescoping it; a hinge mounting for the conduit adapting it to be swung upward, when retracted, out of alinement with the passage, the hinge connection between said extension spout and the conduit permitting upward swing of the latter without full withdrawal of the spout; a weight connected to the conduit to swing it upward; a tension strand connected to the extension spout; a weight connected to said strand to exert a tension thereon tending to hold the spout extended in normal operative relation to the conduit; and means training said strand and operative to relieve the tension thereon as the conduit is swung upward and thereby permit free flexure between the conduit and spout.

8. In an extrusion apparatus including an extrusion chamber and a supply container for molten metal, the extrusion chamber having a charging passage to receive the molten metal, a delivery conduit leading from said container to said charging passage; a hinge support for said conduit adapting it to swing upward out of alinement with the charging passage; an extension spout extending from the delivery end of the conduit inward through the charging passage; and a hinge connection between the conduit and said spout permitting the conduit to be swung upward without full withdrawal of the spout from the charging passage; means to swing the conduit upward; and means to automatically restore the spout to extended position in the charging passage when the conduit is restored to alinement with said passage.

9. In a metal extrusion apparatus including an extrusion chamber having an air-tight charging and cleaning out passage, an extrusion ram mounted to reciprocate in the extrusion chamber and a supply container for molten metal having a discharge port, an airtight delivery conduit leading from said discharge port to said charging passage and comprising telescoping tubular sections; means to exclude air from said discharge port and the adjacent end of the conduit; an air-tight hinge connection between the adjacent end of the conduit and said chest adapting the conduit to swing vertically; an airtight releasable juncture between the opposite end of the conduit and said charging passage; an extension spout hinged to the conduit and extending therefrom through said charging passage; and rack and pinion means carried by the conduit and operable to telescope the conduit to retract the latter from the charging passage, the hinge connection between the conduit and extension spout permitting said upward swing of the conduit while the discharge end of the spout remains in the charging passage.

10. In a metal extrusion apparatus including an extrusion chamber having an airtight charging and cleaning out passage and an extrusion ram mounted to reciprocate in the extrusion chamber, an air-tight delivery conduit leading to said charging passage and having an air-tight juncture therewith; means to enable introduction of molten metal into said conduit and prevent introduction of air; and means for heating said conduit.

11. In the combination of an extrusion mechanism comprising an extrusion chamber and an extrusion ram reciprocable in said chamber and a fluid pressure mechanism operatively connected to the ram and spaced from the extrusion mechanism and tie rods connecting said mechanism and holding

them in spaced tandem relation, walls surrounding the tie rods and defining an air-tight chamber between said mechanisms and surrounding the ram; means to charge said chambers with a non-oxidizing gas; and means to retain said gas in the extrusion chamber.

12. In an extrusion apparatus including an extrusion chamber, an extrusion ram mounted to reciprocate in said chamber and a chamber back of the extrusion chamber and surrounding the ram, means to exclude air from said chambers to prevent oxidation of the extrusion metal, said chamber back of the extrusion chamber having a cleaning out aperture; an air-tight closure for said cleaning out aperture; and toggle means to hold said closure in closed position and operable to shift the closure to open position.

13. In an extrusion apparatus including an extrusion chamber, an extrusion ram mounted to reciprocate in said chamber and a chamber back of the extrusion chamber and surrounding the ram, means to exclude air from said chambers to prevent oxidation of the extrusion metal, said chamber back of the extrusion chamber having a cleaning out aperture; an air-tight closure for said cleaning out aperture; toggle means to hold said closure in closed position and operable to shift the closure to open position; means to charge said chambers with a non-oxidizing gas; and a blow-off valve carried by said closure to relieve excess gas pressure in the chamber.

14. In the combination of an extrusion mechanism comprising an extrusion chamber and an extrusion ram reciprocable in said chamber and a fluid pressure mechanism operatively connected to the ram and spaced from the extrusion mechanism, and tie rods connecting said mechanisms and holding them in spaced relation, the extrusion mechanism having an air-tight chamber between it and the fluid pressure mechanism and surrounding the ram and having a cleaning out aperture; an air-tight closure for said cleaning out aperture; and toggle means for holding said closure in closed position and operable to shift it to open position and including a ring encircling one of the tie rods and rotatable thereon and a link pivoted at one end to said ring and pivoted at its opposite end to the closure.

15. In an extrusion apparatus for cable covering including a tubular cable conduit, a casing forming an annular extrusion chamber surrounding said conduit and having an approximately tangential charging passage leading to said chamber, an annular extrusion ram surrounding said conduit and mounted to shift through the extrusion chamber longitudinally of the cable conduit, and fluid pressure operated means to shift the ram, means defining an air-tight chamber surrounding the ram between the extrusion chamber and said fluid pressure operated means to prevent leakage of air past the ram to the extrusion chamber; an airtight delivery conduit leading to said charging passage to deliver extrusion metal; and an air-tight juncture between said passage and delivery conduit.

In testimony whereof I hereunto affix my signature.

FRANK L. DAVIS, JR.