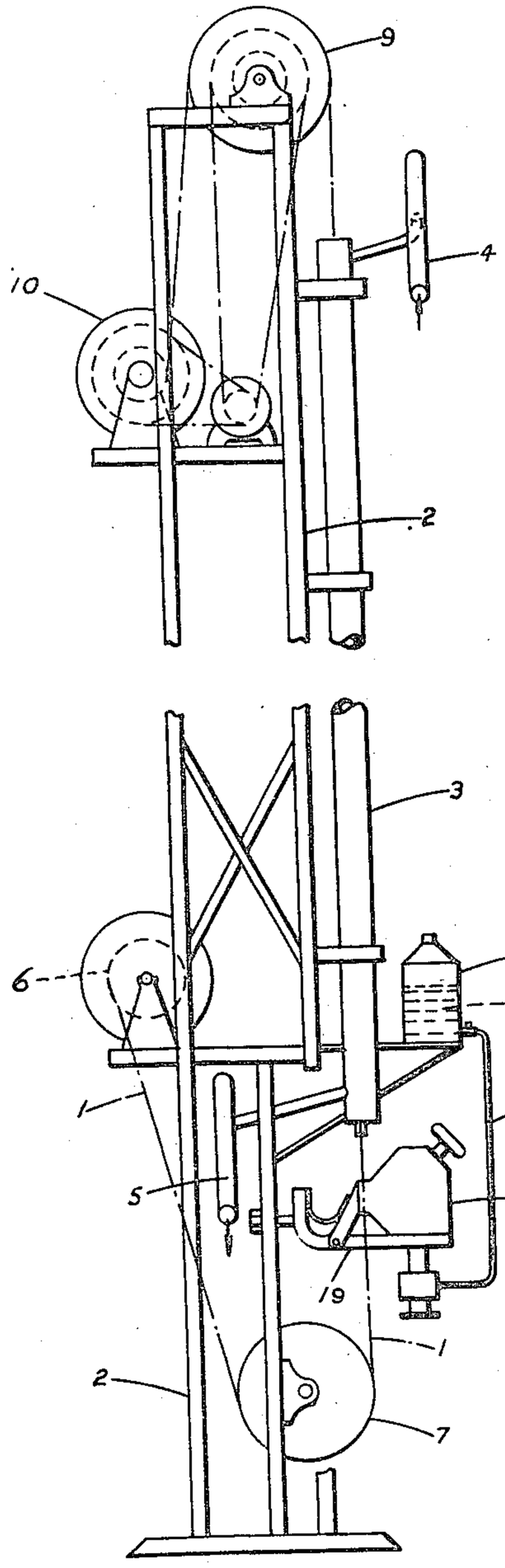
Oct. 31, 1950 H. R. LORCH ET AL 2,528,009

APPARATUS FOR THE COATING OF WIRE

Filed Sept. 7, 1946 3 Sheets-Sheet 1

FIG. 1.

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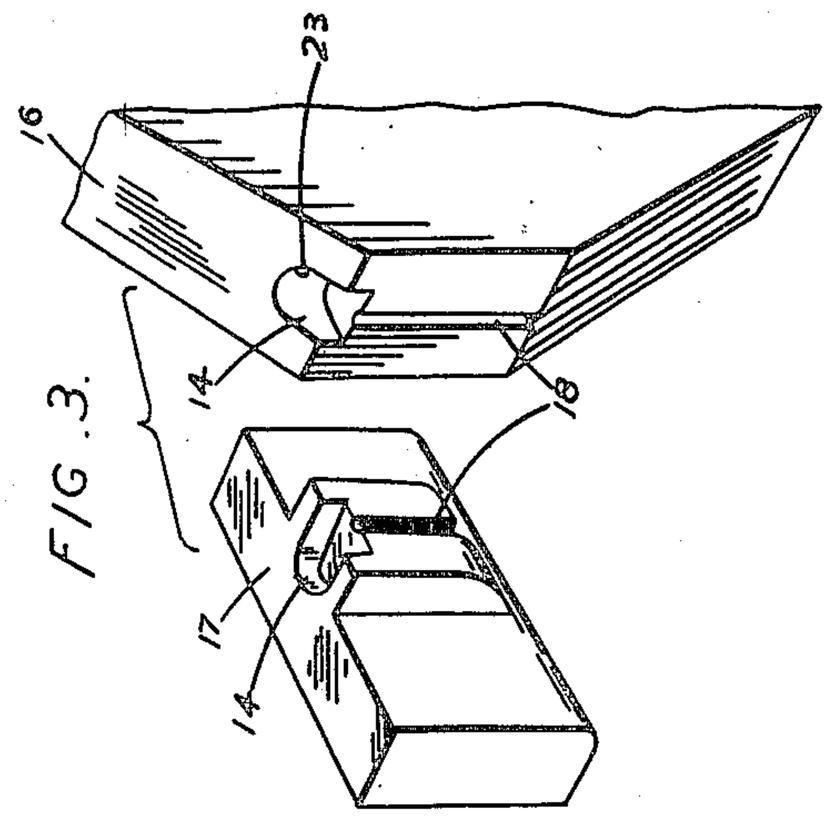


FIG. 3.

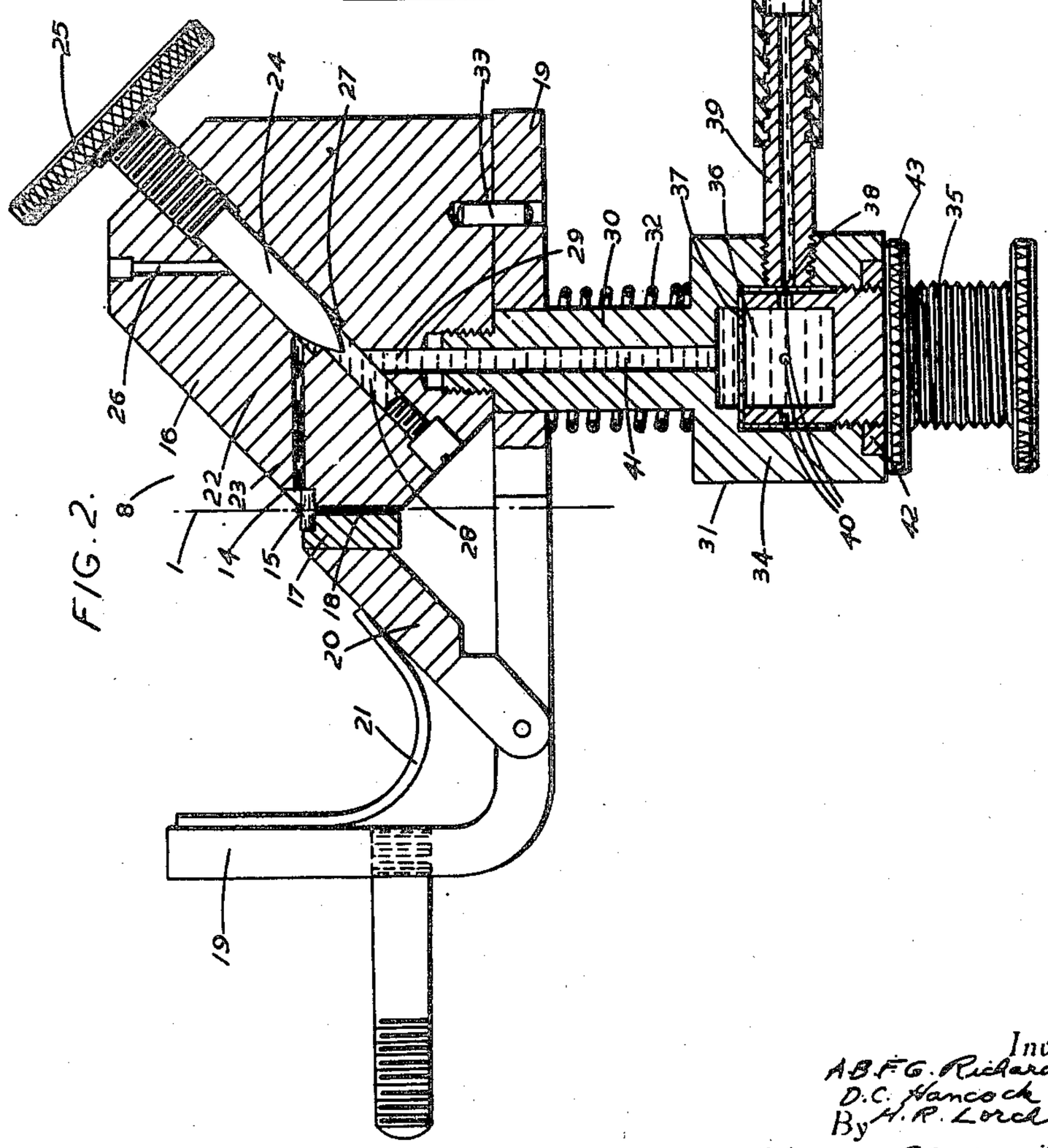


FIG. 2.

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FIG. 4

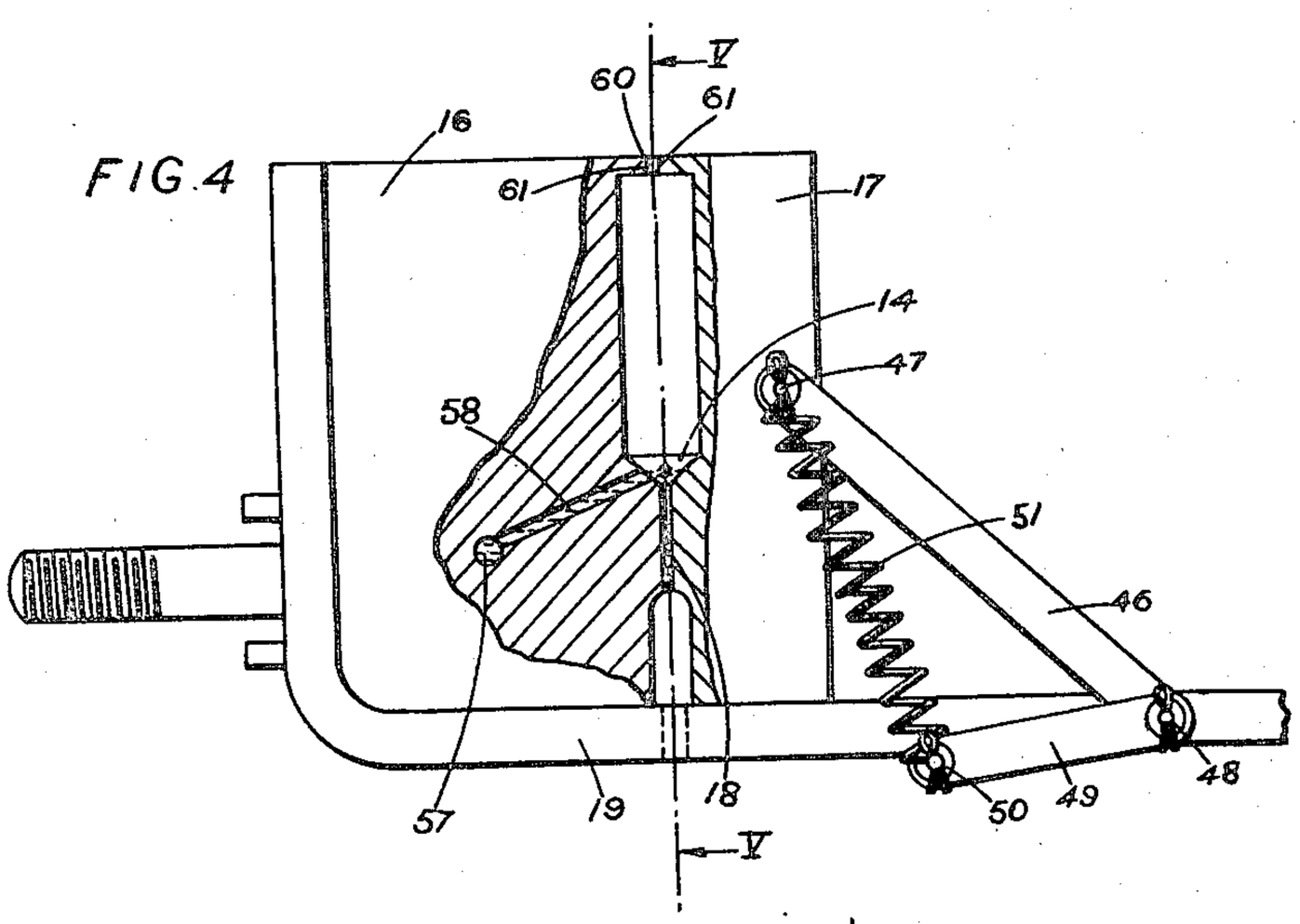



FIG. 5.

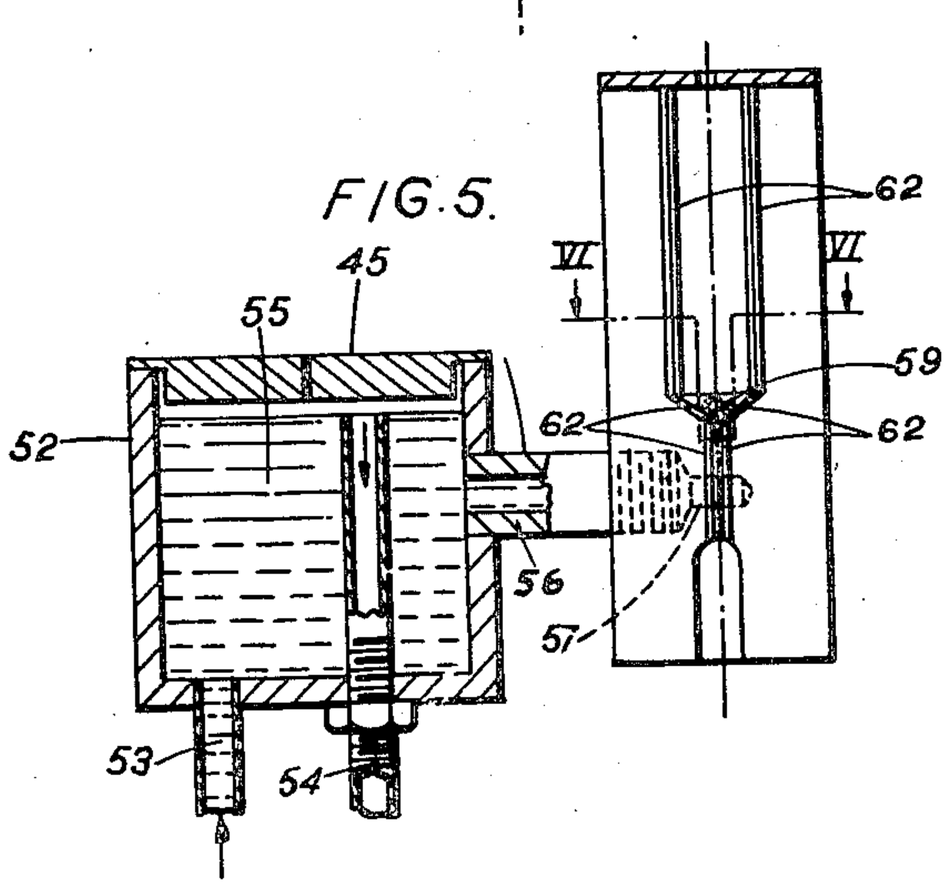
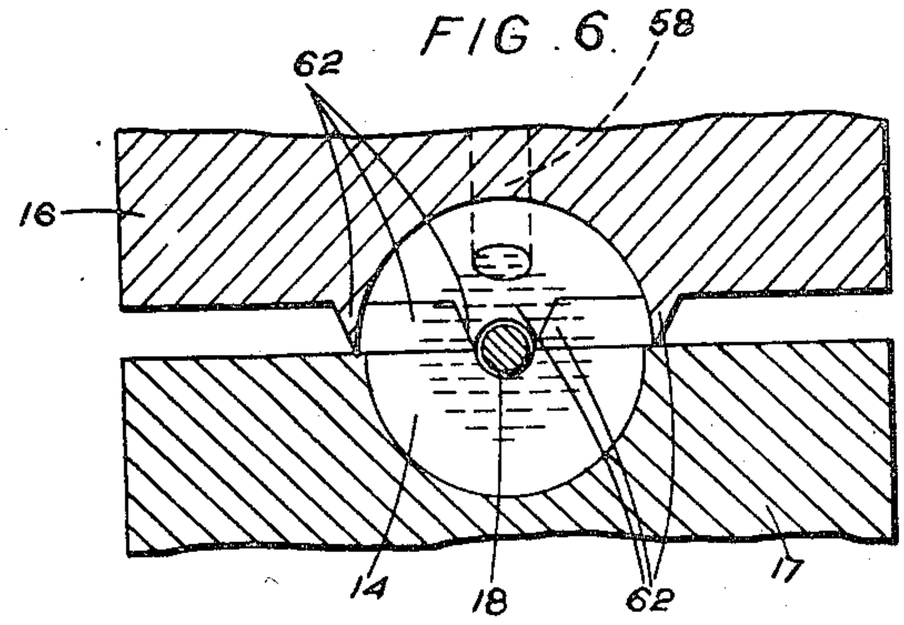



FIG. 6.

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## APPARATUS FOR THE COATING OF WIRE

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9 Claims. (Cl. 91—46)

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This invention relates to apparatus for coating wire by applying a thin layer of liquid (or semi-liquid) material to the wire and then subjecting it to heat to dry or set it, the coating and drying taking place as the wire is continuously moved forward through the apparatus. The invention relates particularly to the device for applying the liquid to the wire. It may be used for coating liquids of several kinds, for instance of the kind used to provide the so-called enamelled wire, or it may be used for applying a latex or an aqueous dispersion of a coating material, for instance an aqueous dispersion of polyvinyl chloride or of a material of which polyvinyl chloride is the principal and characteristic ingredient. The improved apparatus is particularly adapted to the application of latex and aqueous dispersions in that it secures the minimum exposure of the surface of the coating liquid to the atmosphere before the application of the liquid to the wire and thereby avoids the drying and skin producing effect of such exposure and avoids or minimises the subjection of the coating liquid to coagulating influences before it reaches the wire.

The improved apparatus is of the kind in which the wire is coated by passing it upwards through a pool of the coating liquid having a free upper surface. In accordance with the invention the pool is contained in a tiny cup formed of two parts which are separable in a vertical plane and normally urged together by resilient means. In the wall of the cup is a lateral passage for the inflow of coating liquid. For the entry of the wire there is in the bottom wall of the cup a relatively long passage, that is to say, long compared with its bore, formed partly in the face of one part of the cup and partly in the face of the other part and extending upwards into about the centre of the bottom of the cup. This passage is only slightly larger than the greatest size of the wire which has to pass through it and is of such a length that, without the aid of a sealing washer or gland, coating liquid, when under atmospheric pressure, is prevented from escaping by it through the annular space between the wire and the wall of the passage, the dimensions of the passage being so chosen that in the continuous upward movement of the wire, the viscous drag on the wire is sufficient to prevent leakage through the passage. The liquid penetrates downward only to a small proportion of the length of the passage through the upper end. Means are provided for controlling the rate of flow of liquid through the lateral passage into

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the cup so that liquid is supplied to the cup at the rate at which it is drawn from the upper free surface of the pool therein by the wire which passes out of the cup through an opening too large for its wall to have any wiping action on the coated wire. By the term "tiny cup" we mean a cup having an internal radius of the order of one tenth of one inch. With such a cup the pool through which the wire is passed is little more than a single drop of liquid.

The feed of liquid to the cup may be controlled by a valve which can be accurately adjusted and limits the size of an aperture through which the liquid coming from a reservoir under a substantially constant head flows on its way to the cup. Alternatively, the cup is fed from a constant level reservoir, the level of the liquid in which approximates to the required level of the liquid in the cup, the level in the reservoir being accurately so adjusted that the liquid only just fills the passage of fine bore which in this case will in general incline upwards from a point well below the surface of the liquid in the reservoir to the point where it enters the cup which latter point is preferably as near as practicable to the bottom. In neither case is there any wiping of the wire above the pool and there is substantially no run back of the liquid taken up by the wire. The conditions are set or adjusted by the control means, for instance, the valve or the means for adjusting the level of the reservoir, so that the liquid is supplied to the pool at the rate at which liquid is removed from the pool by the wire travelling through it. Thus the whole of the exposed upper surface of the pool moves inwardly and converges on to the wire without restraint and at a rate depending upon the nature of the liquid and the speed of travel of the wire. With some materials it is advantageous to provide a cover more or less enclosing the space above the pool as a further precaution against evaporation and contact with the atmosphere. In this case the opening through which the wire leaves the cup will be smaller than in the case of an open cup but it will still be too large for its wall to have any wiping effect on the coated wire.

The accompanying drawings show by way of example two alternative forms of apparatus for coating wire by our improved method. In these drawings

Figure 1 is a diagrammatic side view of a machine for applying a single coating of polyvinyl chloride latex to a wire and drying the coating thereon,

Figure 2 is a section through the coating device of the machine shown in Figure 1,

Figure 3 is an isometric view on an enlarged scale of the two halves of the cup of the device shown in Figure 2,

Figure 4 is a side view of an alternative form of coating device,

Figure 5 is in part an end view of one half of the cup of the device shown in Figure 4 and in part a sectional elevation of the reservoir from which it is supplied,

Figure 6 is a fragmental section, taken on the line VI—VI of Figure 5 and drawn to a larger scale than Figure 5, showing the cross sectional shape of the two halves of the cup.

Referring first to Figure 1 of the drawings it will be seen that the device for coating a wire 1 is mounted on a frame 2 and in alignment with a vertical tubular oven 3 mounted in front of the frame. This oven comprises a jacketed tube through the jacket of which hot vapour is passed, entering by way of the feed header 4 and leaving by way of an outlet header 5. Wire drawn off from a supply bobbin 6 passes round the pulley 7 and up through the coating device 8. Immediately on leaving the device 8 it enters the oven 3. From the top end of the oven the coated wire passes over a driven pulley 9 on to a driven take-up reel 10. Coating liquid 11 is fed from a reservoir 12 through a flexible tube 13 to the coating device 8.

The construction of the form of coating device fitted to the apparatus shown in Figure 1 is shown in Figures 2 and 3 of the drawings and will be described in detail. The cup 14 for the pool 15 of coating liquid is formed of two parts 16 and 17 which are separable in a vertical diametrical plane and normally pressed together in register, and the vertical passage 18 for the entry of the wire 1 into the centre of the bottom of the cup is formed partly in the face of one of the two parts 16 and 17 and partly in the face of the other. This facilitates the threading up of the device and permits, by the temporary separation of the parts, the passage of a knot joining two lengths of wire, of a kink or some other local thickening and avoids breaking the wire. The part 16 is a block of rigid material, for instance ebonite, carried on a support 19 attached to the frame 2; the part 17 a smaller block of rigid material carried on an inclined arm 20 hinged at its lower end to the support 19 and pressed down by a spring 21 so that the block 17 is normally held in register with the block 16.

From the lower end of an inclined valve chamber 22 in the interior of the block 16, a passage 23, conveniently a horizontal passage, leads into one side of the cup. In the valve chamber is a screw threaded needle valve spindle 24 with an external hand wheel 25 for convenient adjustment of the setting of the valve. From the upper end of the valve chamber a vent 26 is provided so as to avoid any air lock. The valve screws down towards or on to a seating 27 in the lower end of the chamber 22. Into an inclined passage 28 beyond the valve enters a vertical passage 29 whose lower end is of increased diameter and screw threaded to receive the stem 30 of a filter device 31. This stem is a sliding fit in a hole in the support 19 and a helical spring 32 serves to hold the block 16 down on the support 19 under normal working conditions, a dowel pin 33 serving to prevent the block and its stem from turning about the axis of the stem. The filter



device comprises a hollow cylindrical body 34 open at its lower end and a hollow plug 35 which screws into the body 34 to form a chamber 36 divided into upper and lower parts by a filter disc 37 clamped between the end wall of the plug and a seating in the body 34. Between the upper part of the plug and the cylindrical wall of the body is a clearance 38. Liquid is fed into this clearance by a feed pipe 39 and passes into the lower part of the chamber 36 through holes 40 in the plug wall. The upper part of the chamber is in communication with the vertical passage 29 in the block 16 through a passage 41 in the stem 30. Leakage between the body and the plug is prevented by packing held compressed by the ring 42.

The operation of the coating device will be apparent. It will merely be pointed out that the method of mounting the two blocks 16 and 17 greatly facilitates cleaning. By raising the block 16 against the downward thrust of the spring 32 sufficiently to withdraw the dowel, the block can be rotated to bring its face into an accessible position and to leave the face of the block 17 clear.

In order to avoid or minimise penetration of the liquid between the faces of the two parts in which the cup and passage are formed and its resultant coagulation therein, it has been found necessary to restrict the area of contact of the fitting faces of the two parts so that these faces are narrow strips or lands, one on each side of the cup and the passage. These may take the form shown in Figure 3 or knife edges may be provided on the face of one block as in the alternative form of coating device now to be described with the aid of Figures 4, 5 and 6 of the drawings.

The modified form of coating device shown in Figures 4, 5 and 6 differs from that just described, principally in the method of mounting the movable block 17 and in that the needle valve and filter device are dispensed with and the cup fed by means of a constant level feed device 45. Referring to Figure 4, it is explained that the block 17 is pivotally secured near its centre to a pair of links 46, one on each side of the block, by pivot pins 47. The lower ends of these links are pivotally secured to the support 19 by the pivot pins 48 which each carry a second and shorter link 49. The free ends of these links 49 are coupled by a rod 50 passing beneath the support 19. Each pivot pin 47 is coupled to the rod 50 by a tensioned coil spring 51. The springs 51 normally maintain the two blocks 16 and 17 in contact and in register. By swinging the links 49 down and away from the block through an angle of nearly 180°, the springs are first extended and then, as the dead centre position is passed, contract and in so doing swing block 17 away from and clear of block 16 which in this case is positively secured to the support 19.

The constant level feed device comprises a vessel 52 and a feed inlet 53 and an overflow pipe 54 vertically adjustable to control the level of liquid 55 in the vessel which is preferably covered by a loosely fitting lid. Below the level of the liquid is an outlet pipe 56 which enters the block 16 and delivers liquid into a chamber 57 therein. From the chamber 57 an inclined passage 58 leads up to the cup 14 which it enters by an opening approximately on the same level as the surface of the liquid in the vessel 52. It has been found that a satisfactory inflow into the cup is obtained when the surface of liquid in the

vessel is adjusted to be level with the centre line of the opening 59 into the cup. It is possible in practice to make the passage 58 so small in diameter and so to restrict the amount of liquid in the cup or well that when the two halves of the cup are momentarily forced apart by a lump or join in the wire, the loss of liquid does not exceed one or two drops.

In some cases it is advantageous to reduce evaporation from the surface of the liquid in the cup. This is effected in the arrangement shown in Figures 4 and 5 by increasing the depth of the cup until it assumes the form of a well and closing the top of this well, except for a small aperture 60 for the wire, by inwardly extending projections 61 at the top of the semi-cylindrical grooves in the blocks, by which the well is formed. The aperture 60 is as small as convenient without risk of its wall touching the coated wire as it is drawn from the well.

As will be seen from Figures 5 and 6, on the face of the fixed member 16 are provided knife edges 62 along the edges of the recesses forming one half of the cup or well and of the passage 18 for the entry of the wire. These make substantially line contact with the opposite portions of the face of the moving member 17, which portions are flat.

What we claim as our invention is:

1. Apparatus for applying a coating of liquid material to a wire, comprising a cup for containing a pool of liquid from a reservoir, said cup having in a wall thereof a passage of fine bore for feeding liquid into the cup below the working level of the pool and having in its bottom wall a central vertical hole of relatively small diameter as compared with that of the cup, for the upward passage of the wire, the bore of the hole and the length thereof being such that during upward movement of the wire through the hole, the surfaces of the wire and of the hole co-operate to prevent escape of liquid through the space between the wire and the wall of the hole, in combination with an accurately adjustable valve for controlling the inflow of coating liquid through the feed passage of fine bore independently of the height of liquid in the reservoir.

2. A device for applying a coating of liquid material to a vertically travelling wire, comprising a cup for containing a pool of the coating material, a valve chamber, a lateral passage of fine bore placing the interior of said valve chamber in communication with the interior of said cup, a second chamber in communication with said valve chamber through an opening in the lower end of said valve chamber, a seating around the opening in said valve chamber, a needle valve working in said valve chamber and co-operating with said seating to regulate the opening between said valve chamber and the second chamber, a reservoir for coating material higher than said lateral passage and means for conveying coating material from said reservoir to said second chamber.

3. A device for applying a coating of liquid material to a vertically travelling wire, comprising a cup for containing a pool of the coating material, a valve chamber, a lateral passage of fine bore placing the interior of said valve chamber in communication with the interior of said cup, a second chamber in communication with said valve chamber through an opening in the lower end of said valve chamber, a seating around the opening in said valve chamber, a needle valve working in said valve chamber and co-operating



with said seating to regulate the opening between said valve chamber and the second chamber, a filter chamber below said second chamber, filtering means in said filter chamber, means comprising an elevated reservoir for coating material, and a conduit for conveying coating material from said reservoir to said filter chamber, for forcing coating material through the filter, and means for conveying filtered coating material from the filter chamber to the second chamber.

4. A device for applying a coating of liquid material to a vertically travelling wire, comprising a support, a cup for containing a pool of the coating material and a vertical passage for the wire leading into the bottom of the cup, said cup and the passage being formed in two parts separable in a vertical plane, one of said parts being hinged to said support and the other being rotatable on said support about a vertical axis, a releasable locking device for preventing rotation of the rotatably supported part, resilient means for holding the hinged part of said cup in register with the locked rotatably supported part, and means for feeding coating material to said cup at a controlled rate through a passage in the rotatably supported part of said cup.

5. Apparatus for applying a coating of liquid material to an upwardly travelling wire, comprising a tiny cup formed of two parts separable in a vertical plane and having a lateral passage in the wall of said cup for the inflow of coating liquid to maintain a pool of liquid in the cup and, for the entry of the wire, a relatively long passage of small diameter as compared with that of the cup, formed partly in the face of one part of the cup and partly in the face of the other part and extending upwards into about the centre of the bottom of the cup, the bore of the upwardly extending passage and the length thereof being such that, without the aid of a sealing washer or gland, coating liquid when under atmospheric pressure is prevented from escaping through the annular space between the wire and the wall of the passage by the upward movement of the wire, resilient means normally urging said parts together, means for controlling the rate of flow of liquid through the lateral passage into the cup at the rate at which liquid is drawn from the upper free surface of the pool in the cup by the wire which passes out of the cup through an opening too large for its wall to have any wiping action on the coating.

6. A device for applying a coating of liquid material to a vertically travelling wire, comprising a pair of blocks of rigid material, a support for said blocks, means for fixing one of said blocks to said support, means for pivotally securing the other block to said support, a vertical face on said fixed block, a face on said pivotally secured block, resilient means for pressing said face on said pivotally secured block into engagement with said vertical face on said fixed block, said faces having recesses and co-operating to form a cup for containing a pool of the coating material and a vertical passage leading to said cup, a valve chamber in said fixed block, a lateral passage of fine bore in said fixed block extending from the cup to said valve chamber, a second chamber in said fixed block in communication with said valve chamber through an opening in the lower end of said valve chamber, a seating around the opening in said valve chamber, a needle valve working in said valve chamber and co-operating with said seating to regulate the

opening between said valve chamber and the second chamber, a reservoir for coating material higher than said lateral passage and means for conveying coating material from said reservoir to said second chamber.

7. A device for applying a coating of liquid material to a vertically travelling wire, comprising a support, a cup for containing a pool of the coating material, and a vertical passage for the wire leading into the bottom of the cup, said cup and the passage being formed by registering recesses in neighbouring vertical faces of two blocks of rigid material, means for fixing one of said blocks to said support, means for pivotally securing the other of said blocks to said support, and resilient means normally urging said pivotally secured block towards said fixed block to make a joint between said recessed vertical faces, the said vertical faces being in contact with each other adjacent the cup and passage only in areas lying within a pair of narrow strips bordering opposite sides of the cup and passage, thereby limiting the area of fluid penetration between the said faces of fluid from the cup and passage.

8. A device for applying a coating of liquid material to a vertically travelling wire, comprising a support, a cup for containing a pool of the coating material, and a vertical passage for the wire leading into the bottom of the cup, said cup and the passage being formed by registering recesses in neighbouring vertical faces of two blocks of rigid material, means for fixing one of said blocks to said support, means for pivotally securing the other of said blocks to said support, and resilient means normally urging said pivotally secured block towards said fixed block to make joint between said recessed vertical faces, said recessed vertical face of at least one block having lands one on each side of said cup and passage whereby to restrict the area of contact between said two blocks.



9. A device for applying a coating of liquid material to a vertically travelling wire, comprising a support, a cup for containing a pool of the coating material, and a vertical passage for the wire leading into the bottom of the cup, said cup and the passage being formed by registering recesses in neighbouring vertical faces of two blocks of rigid material, means for fixing one of said blocks to said support, means for pivotally securing the other of said blocks to said support, and resilient means normally urging said pivotally secured block towards said fixed block to make joint between said recessed vertical faces, said recessed vertical face of at least one block having knife edges one on each side of said cup and passage whereby to restrict the area of contact between said two blocks.

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