Sept. 20, 1971 F. B. KILCOIN 3,605,466

APPARATUS FOR DRAWING METAL WIRE AND THE LIKE AND THE METHOD THEREOF

Original Filed Oct. 11, 1967

FIG. 1

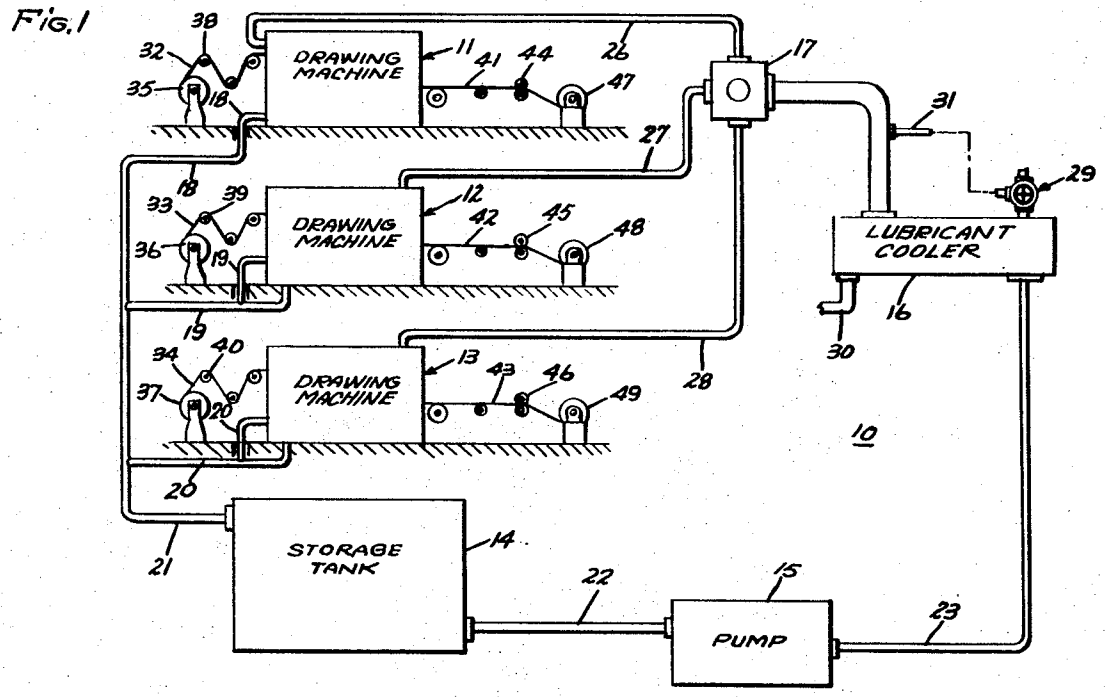
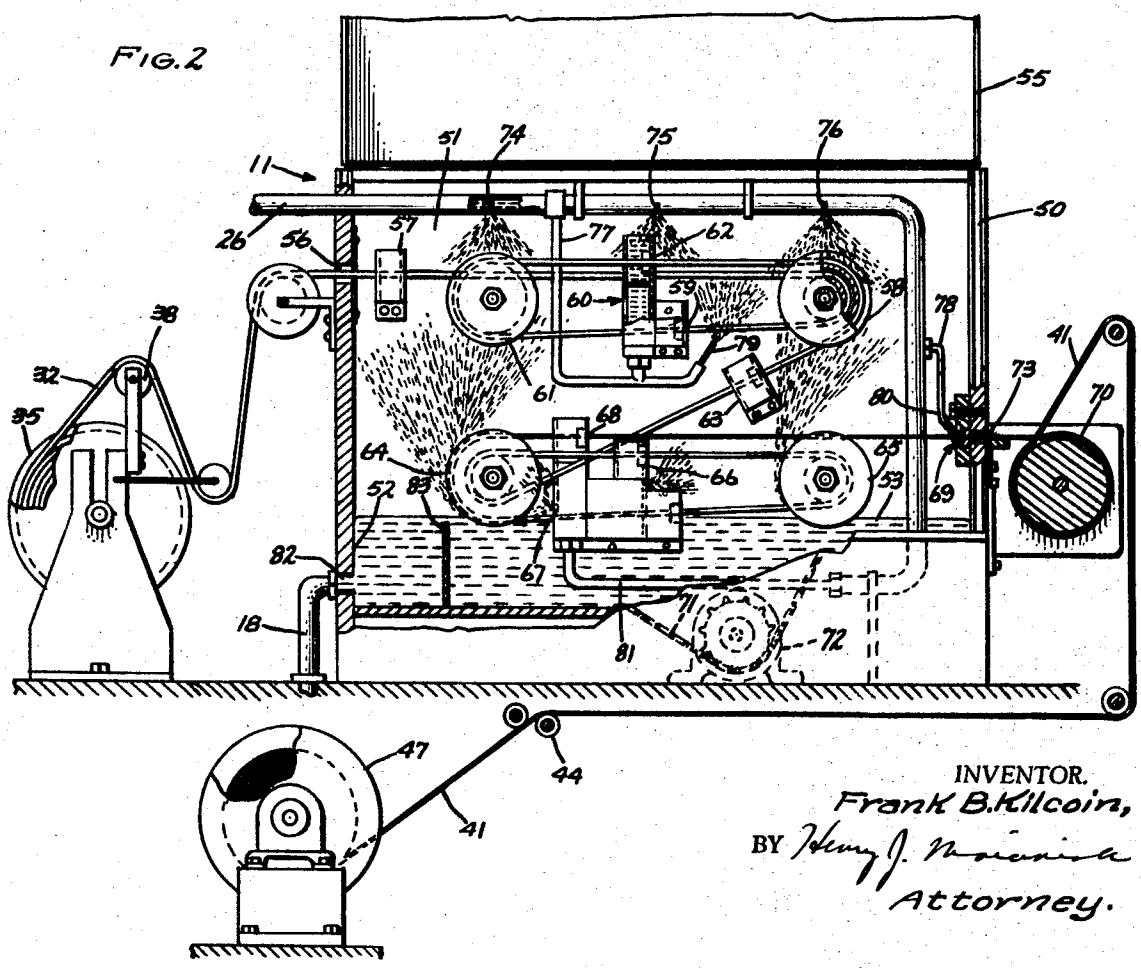


FIG. 2



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3,605,466

APPARATUS FOR DRAWING METAL WIRE AND THE LIKE AND THE METHOD THEREOF

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Continuation of application Ser. No. 674,537, Oct. 11, 1967. This application Nov. 26, 1969, Ser. No. 880,227
Int. Cl. B21b *45/02*
U.S. Cl. 72—43 7 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus and method for drawing continuously moving aluminum wire. The apparatus includes one or more drawing machines having a housing that forms a drawing chamber and a reservoir for liquid drawing lubricant. Drawing dies are mounted within the drawing chamber in coaxial relationship with respect to the moving wire, and at least an upper and a lower tier of drawing blocks direct and pull the moving wire through the dies. The level of the drawing lubricant in the reservoir is maintained above a predetermined level so that the liquid lubricant wets at least one of the drawing blocks of the lower tier thereby to cause the liquid lubricant to be sprayed and cooled by the drawing block or blocks of the lower tier. The drawing machine is connected in a closed flow loop which includes a storage tank, a pump, a lubricant cooler and control valve.

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation application of application Ser. No. 674,537, filed Oct. 11, 1967, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to the fabrication of metal wire and more particularly to an improved apparatus for drawing aluminum wire and the method thereof.

In apparatus for drawing continuously moving wire, wire is passed through a series of dies in a drawing machine. The moving wire is pulled through the dies by drawing blocks. While the wire is being drawn successively through the series of dies, liquid lubricant is sprayed over the wire, the dies, and drawing blocks. Excess liquid lubricant is returned to a storage tank, and additional lubricant is pumped from the storage tank through a cooler to the drawing machine.

Problems have been encountered with such drawing machines where lubricants, such as the olefinic compositions, having relatively low latent heats of evaporation are employed. Although the temperature of the lubricant in the reservoir of the drawing machine is not significantly increased, a loss of lubricant resulting from evaporation of the liquid lubricant at the dies has in some applications been excessive. Also, where aluminum wire is being drawn, difficulty has been experienced in wire sticking to the drawing blocks. It will be appreciated that excessive loss of lubricant is not only costly but also may present health hazards to operating personnel. Wire sticking to the drawing blocks may not only damage the wire but frequently may necessitate stopping the operation of the drawing machine.

Accordingly, it is an object of the invention to provide an improved apparatus for drawing metal wire and the method thereof.

It is a more specific object of the invention to provide an improved apparatus and method for drawing continuously moving aluminum wire wherein excessive vaporization of an olefinic lubricant is effectively reduced.

Another specific object of the invention is to provide an improved apparatus and method for drawing aluminum wire wherein sticking of the continuously moving wire passing through the drawing machine is minimized.

SUMMARY OF THE INVENTION

In accordance with one form of my invention, I have provided an improved apparatus and method for drawing continuously moving aluminum wire. The apparatus includes one or more drawing machines having a housing that defines a drawing chamber and a reservoir for liquid drawing lubricant, an entrance opening for the entry of the moving wire into the drawing chamber and an exit opening for the moving wire leaving the drawing chamber. In the drawing chamber dies are mounted in generally coaxial relationship with respect to the moving wire, and at least first and second levels, such as an upper and lower tier, of drawing blocks are provided for pulling and guiding the moving wire through the dies. Suitable sprayers are positioned within the drawing chamber for applying liquid drawing lubricant during operation to the dies, drawing blocks and moving wire.

According to one aspect of my invention, I have provided a means for maintaining the level of the liquid drawing lubricant in the reservoir of the housing above a predetermined level whereby the liquid drawing lubricant wets one or more of the drawing blocks of the lower tier to thereby cause the liquid drawing lubricant to be sprayed by the rotating action of the blocks. In a more specific aspect, I have employed a damming plate in the reservoir to insure that the liquid drawing lubricant does not fall below the desired predetermined level.

By another aspect of the present invention, I provide an improved method for drawing continuously moving aluminum wire including the steps of guiding and pulling aluminum wire in at least two levels through the dies by the number of drawing blocks arranged in the at least first and second levels in the housing. Liquid drawing lubricant is cooled and sprayed from the reservoir generally toward the drawing blocks of the second level within the housing by wetting at least one rotatable drawing block of the first level with liquid drawing lubricant from the reservoir as a portion of the at least one drawing block is being rotated in the reservoir, thereby causing the lubricant to be thrown away from the rotating portion. This lubricant is directed into contact with at least one rotatable drawing block of the second level, and additional lubricant is sprayed onto the same block from locations other than the at least one rotating drawing block of the first level. The liquid drawing lubricant in the reservoir is maintained at a level sufficient to wet the rotating portion of the at least one rotatable drawing block as the aluminum wire is being guided and pulled through the dies in the housing. Also, the closed flow loop is provided for circulating the liquid drawing lubricant as the aluminum wire is being guided and pulled through the dies.

Important advantages of this invention are that it makes it possible to achieve relatively lower lubricant temperatures within the drawing chamber, to achieve a more effective lubrication of the wire at the blocks thereby to minimize wire sticking, and to reduce lubricant loss resulting from evaporation.

Further aspects and advantages of the invention will become apparent from the more detailed description of the invention which follows. It will be understood that the specification concludes with claims which clearly point out and distinctly claim the subject matter which I regard as my invention. The invention, however, both as to organization and method of operation, may be best understood with reference to the following description taken in conjunction with the accompanying drawing in which:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic representation of one form of the improved apparatus, particularly suited to practice the method, the figure illustrating a system wherein three drawing machines are employed to draw three strands of continuously moving wire; and

FIG. 2 is an elevational view of the drawing machine with portions thereof cut away to illustrate the internal arrangement of the components of the drawing machine.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more specifically to FIG. 1 of the drawings, I will now more fully describe one form of the apparatus, particularly suitable to practice the method, for drawing continuously moving wire, which is generally identified in the drawing by the reference numeral **10**. It will be seen that the apparatus **10** includes three drawing machines **11**, **12** and **13**, which are connected in a closed lubricant flow loop. This flow loop includes a storage tank **14**, a pump **15**, a lubricant cooler **16** and a control valve **17**.

Liquid drawing lubricant from the reservoirs of the drawing machines **11**, **12** and **13** return by gravity flow through return lines **18**, **19** and **20** joined to a common line **21** connected to the storage tank **14**. The suction side of pump **15** is connected with the storage tank **14** by a section of piping **22** while the discharge side of the pump **15** is connected by suitable piping **23** to the lubricant cooler **16**. Liquid drawing lubricant leaving the lubricant cooler **16** passes through a control valve **17** which regulates the quantity of lubricant supplied to the individual drawing machine inlet lines **26**, **27** and **28**.

In the illustrated exemplification of the invention, cooling water is admitted to the header of the lubricant cooler **16** by means of an inlet valve **29** and leaves the lubricant cooler at the outlet connection **30**. Further, in the exemplification of the invention a conventional temperature sensing device was used to sense the temperature of the liquid drawing lubricant leaving the lubricant cooler **16**. The temperature sensing device is connected in a conventional circuit that controls valve **29** to vary the amount of water admitted into the lubricant cooler **16** in response to changes from a preselected lubricant temperature thereby to maintain the temperature of the lubricant at the preselected level.

The wires **32**, **33** and **34** to be drawn by the drawing machines **11**, **12** and **13** are brought out from pay-off reels **35**, **36** and **37** over series of guide sheaves **38**, **39** and **40**. The finished drawn wires **41**, **42** and **43** leave the drawing machines **11**, **12** and **13** at the opposite sides and pass over guide sheaves **44**, **45** and **46** to storage reels **47**, **48** and **49**. Although in the exemplification of the invention, the finished wires **41**, **42** and **43** are shown being fed to storage reels **47**, **48** and **49**, it will be appreciated that the wires leaving the drawing machines may be fed directly to an annealing oven, enameling oven, or other wire processing equipment.

In the apparatus **10** exemplifying one form of my invention, aluminum wire was drawn. It will be understood that the term "aluminum" as used herein is intended to include not only aluminum itself but also compositions in which the aluminum is present in an amount equal to at least 50% of the total weight of the composition, as for example, aluminum alloys. Representative aluminum compositions that may be drawn with the apparatus **10** are disclosed on pages 851–853 and 865–958 of Metals Handbook, volume 1, Properties and Section of Metals, American Society of Metals, Novelty, Ohio, Eighth edition (1961). Although wire fabricated of aluminum was used in the apparatus exemplifying my invention, it will be appreciated that the apparatus **10** may be used to draw other metal wires.

Having more specific reference now to FIG. 2, I will now more fully describe the drawing machine **11**. The other two drawing machines **12** and **13** are of substantially identical construction, and therefore the detailed description respecting drawing machine **11** is, of course, applicable to the drawing machines **12** and **13**.

The drawing machine **11** includes a housing **50** that forms an enclosure for a drawing chamber **51** and a reservoir **52** for liquid drawing lubricant **53**. In order to make the drawing chamber **51** readily accessible, a hinged cover **55**, a portion of which is cut away as shown in FIG. 2, forms a wall of the housing **50**. The wire **32** from the pay-off reel **35** enters the housing **50** through an entrance opening **56**, is pulled through a first die **57** by drawing block **58**, through die **59** of die box **60** by drawing block **61** and through die **62** of die box **60** by drawing block **58**. It will be noted that drawing blocks **58**, **61** form an upper tier for directing and pulling the wire essentially horizontally through dies **57**, **59** and **62**.

The wire leaving drawing block **58** is diagonally pulled through a die **63** by drawing block **64** of the lower tier and then is pulled by drawing block **65** through die **66** of die box **67**. Final finishing of the wire is accomplished as the wire is pulled through the final dies **68**, **69** by the drawing block **70** mounted on the outside of the drawing machine housing **50**.

It will be understood that the drawing blocks are by means of a chain **71** driven by a motor **72**. Since the drawing block drive system employed is conventional, a detailed description is not given herein. For details relating to such systems, reference may be made to U.S. Letters Patent 2,557,215, 2,884,120 and 2,996,170 granted to Carl O. Bruestle.

During operation the dies **57**, **59**, **62**, **63**, **66**, **68** and **69**, the moving wire, and rotating drawing blocks **58**, **61**, **64** and **65** are sprayed with the liquid drawing lubricant within the drawing chamber **51**. The portion of supply line **26** within the drawing chamber **51** is formed with a series of spray nozzles **74**, **75**, **76**. It will be seen that the supply line **26** has two feeder lines **77**, **78** connected with it that lubricate nozzles **79**, **80** respectively. Also, supply line **26** terminates in a feeder line **81** which pours lubricant into die box **67**.

It will be noted that the bottom of the housing serves as a reservoir **52** for the liquid drawing lubricant. In the illustrated exemplification of the invention, the liquid lubricant is returned to the storage tank **14** through an outlet **82** and connection **18** by means of gravity flow.

In accordance with one feature of my invention, I have provided a damming plate **83** which extends transversely across the reservoir to maintain the level of the lubricant to the right of the damming plate **83**, as viewed in FIG. 2, at a predetermined level. The vertical height of the damming plate **83** is designed so that the level of the liquid lubricant in the reservoir is sufficiently high to wet the drawing blocks of the lower tier. With the drawing blocks **64** and **65** partially submerged in the liquid lubricant, considerable quantities of the lubricant are sprayed within the drawing chamber **51**. In particular, it will be noted that the underside of both of the drawing blocks **58**, **61** of the upper tier are sprayed and that additional spraying on the topside of the drawing blocks **64**, **65** of the lower tier is achieved. It is believed that a scattering effect is achieved within the drawing chamber **51** that not only augments the amount of lubricant being applied to the continuously moving wire, drawing blocks and dies, but also produces a pronounced cooling effect. The resultant cooling is found to be an important advantage where aluminum wire is being drawn and where the lubricant is of an olefinic composition since such lubricants have a relatively low latent heat of evaporation. It will be appreciated that the pictorial representation in FIG. 2 of the spray generated by the drawing blocks **64**, **65** is at best a schematic showing.

The olefinic compositions used as a lubricant in the exemplification of my invention are fully described in U.S. Pat. No. 3,288,715, granted to Robert S. Owens and

Leon E. St. Pierre and assigned to the present assignee. The olefinic compositions may be mixed with mineral or hydrocarbon oils having viscosities of from 25 to 10,000 Saybolt Universal Seconds (S.U.S.) and may be a single hydrocarbon or a mixture of hydrocarbons. Although olefinic compositions are preferably used with aluminum wire, it will be appreciated that other lubricants suitable for use with the specific metal composition of the wire may be employed in the practice of this invention.

In the exemplification of my invention, the dies used produced approximately one American Wire Gage size reduction as the aluminum wire passes through a particular die, and the dies were of conventional construction. It will be appreciated that the actual number of dies to be used in a given application will depend on the initial cross-sectional area of the wire being fed into the drawing machine and the desired final size of the finished wire.

From the foregoing description of the apparatus for drawing continuously moving wire and its operation, it will be apparent that I have provided an improved arrangement for achieving lubrication of the components of the drawing machine and for effecting a reduction in the temperature of the liquid drawing lubricant in the drawing chamber. An important advantage of the improved arrangement is that it is possible to minimize sticking of the wire to drawing blocks and also to effect significant reductions in the amount of lubricant loss.

Although the present invention has been described by reference to a particular embodiment thereof, it is to be understood that many modifications may be made to the means for maintaining the lubricant in the reservoir at a selected level without actually departing from the invention. For example, it will be apparent that the level of the lubricant in the reservoir may be maintained by locating the outlet connection at a preselected height thereby to maintain the liquid in the reservoir above a preselected level. Also, it will be apparent to those skilled in the art that the drawing blocks and dies can be rearranged in the drawing chamber without basically changing the functional arrangement. It is, therefore, intended by the appended claims to cover all such modifications that fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for drawing continuously moving aluminum wire, said apparatus comprising a drawing machine including a housing having a drawing chamber, a reservoir for liquid drawing lubricant, an entrance opening for the entry of the moving aluminum wire into the drawing chamber, and an exit opening for the moving aluminium wire leaving said drawing chamber, said drawing machine further including a die means mounted within said drawing chamber in coaxial relationship with respect to the moving aluminum wire, at least an upper and a lower tier of drawing blocks for guiding and pulling the moving aluminum wire through said die means, means for driving said drawing blocks, spraying means positioned within said drawing chamber for applying the liquid drawing lubricant to said die means, said drawing blocks and the moving aluminum wire, and means for maintaining the level of the drawing lubricant in the reservoir of said housing above a predetermined level whereby the liquid drawing lubricant wets at least one of the drawing blocks of said lower tier thereby causing liquid drawing lubricant to be sprayed and thereby to be cooled within the drawing chamber by the rotation of said at least one drawing block; means for storing the liquid drawing lubricant; means for cooling the liquid drawing lubricant; means for pumping the liquid drawing lubricant; and piping means connecting said reservoir and spraying means, said means for storing the liquid drawing lubricant, said means for pumping lubricant and said means for cooling the drawing lubricant thereby to provide a closed flow loop for the circulation of the liquid drawing lubricant.

2. The apparatus set forth in claim 1 wherein said means for maintaining the level of the liquid drawing lubricant includes a damming plate mounted in said reservoir to prevent the level of the drawing lubricant under the drawing blocks of said lower tier from falling below said predetermined level, and the drawing lubricant is an olefinic composition.

3. The apparatus as set forth in claim 1 wherein at least two drawing machines are connected in said closed flow loop, said drawing machines being connected in parallel flow circuit relationship with each other.

4. A method for drawing continuously moving aluminum wire in a housing having a reservoir of liquid drawing lubricant, the method comprising the steps of: guiding and pulling aluminum wire in at least two levels through dies, mounted in coaxial relationship relative to the aluminum wire within the housing, by a number of drawing blocks arranged in at least first and second levels in the housing; cooling and spraying the liquid drawing blocks of the second level within the housing by wetting at least one rotatable drawing block of the first level with lubricant from the reservoir generally toward the drawing liquid drawing lubricant from the reservoir as a portion of the at least one drawing block is being rotated in the reservoir thereby causing liquid drawing lubricant to be thrown away from the rotating portion; and maintaining the liquid drawing lubricant in the reservoir at a level sufficient to wet the rotating portion of the at least one rotatable drawing block as the aluminum wire is being guided and pulled through the dies in the housing.

5. The method of claim 4 in which the liquid drawing lubricant is an olefinic composition mixed with oil having a viscosity in the range from 25 to 10,000 Saybolt Universal Seconds.

6. The method of claim 4 including the step of: directing the cooled and sprayed liquid drawing lubricant into contact with at least one rotatable drawing block of the second level, and spraying the at least one rotatable drawing block of the second level with additional liquid drawing lubricant from locations within the housing other than the at least one rotating drawing block of the first level.

7. The method of claim 6 including the step of providing a closed flow loop for circulating the liquid drawing lubricant as the aluminum wire is being guided and pulled through the dies.

References Cited

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CHARLES W. LANHAM, Primary Examiner

E. M. COMBS, Assistant Examiner

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,605,466 Dated September 20, 1971

Inventor(s) Frank B. Kilcoin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, after line 5 insert -- assignor to General Electric Company, a corporation of New York --.

Signed and sealed this 1st day of August 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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