TUBE EXTRUSION PRESS RUNOUT APPARATUS

ABSTRACT: Tube extrusion press runout apparatus to eliminate or minimize oxidation, to straighten and quench the extruded tube to drain the tube and blow moisture therefrom, to insert a plug and lubricant into one end of the tube, to point the end, and to feed the pointed end of the tube to a die for reduction.
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BRIEF SUMMARY OF THE INVENTION

The present invention relates to all of the equipment necessary to receive extruded tubing and to quench and handle the tubing preparatory to a die reduction.

One of the problems encountered in high speed extrusion is handling of the tubing to eliminate the formation of scale, to avoid surface damage such as nicks, scratches and abrasion, and to receive the tube in perfectly straight condition and to maintain its straightness during operations preparatory to a reduction in a drawing operation.

The problem becomes particularly difficult with modern extrusion presses in which the following capacities may be required:

CAPACITIES

COPPER TUBES

Extruded Temperature 1600 Approx.
Extrusion Speed Up to 2000 FPM
Extrusion Rate 65 Per Hour
O.D. 1-7/8" to 2-1/4"
Wall 0.090" to 0.100"
Length 220' Maximum
Weight 500 Lb. Maximum

COPPER ALLOY TUBES

Extruded Temperature 1450° F. to 1950° F.
Extrusion Rate 45 Per Hour
O.D. 3" to 3-1/2"
Wall 0.250" to 0.450"
Length 50' Maximum
Weight 450 Lb. Maximum

Briefly described, the press runout system includes a short quench tube through which the extruded tube passes and in which it is subjected to a high pressure spray of water or steam, the sprays being arranged in a manner to minimize entrance of air into the system. The extruded tube is advanced at relatively high speed through the quench tube into an elongated runout chamber which is provided at its lower surface with inclined plane surfaces having an included angle slightly greater than 90°. One of these surfaces is formed on a swinging door which may be opened to permit the extruded tube to drop from the runout chamber into a quench tank.

Spray heads are provided at intervals along the runout chamber so that the tube is being cooled while in the runout chamber. The formation of the lower supporting surface as a V is effective to straighten and to maintain the extruded tube straight as it is advanced into the runout chamber.

After the tube has been completely extruded the runout chamber assembly is advanced several feet away from the quench tube, drawing the end of the extruded tube out of the quench tube.

The extruded tube now drops into the quench tank where it is supported at intervals on standards and is retained in the quenching water for a predetermined period depending upon physical conditions of the tube, temperature, etc. Each tube is then lifted from the quench tank by arms and is deposited at one side of an inclined table. In order to incline the tube as it is deposited, the lift arms are of graduated length and the pivot axes thereof are also at different levels.

The complete system may be used for copper tube or alloy tube which require different treatments and the unloading of the tube by the lift arms causes the tube to roll off onto one side or the other depending upon the material of the tube.

The tubes are then advanced transversely by conventional walking beam structure which is arranged to increase the inclination of the tube to a maximum intermediate the edges of the table. At or adjacent the zone of maximum inclination means are brought into registry with the upper end of the tube for blowing air through the tube to blow out all the water which has failed to drain therefrom. Also, the tube is provided with a plug and lubricant in the open end and the end of the tube is pointed for insertion through a draw die for connection to a bull block.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the tube extrusion runout apparatus.
FIG. 2 is a side elevational view of this apparatus with some parts in section.
FIG. 3 is an end view of the apparatus on a somewhat larger scale.
FIG. 4 is a vertical section through the quench tube of the system.
FIG. 5 is a transverse sectional view through the runout chamber.
FIG. 6 is an end view of the system including a diagrammatic view of the table.
FIG. 7 is an enlarged elevational view of the lift-out mechanism associated with the quench tank.

DETAILED DESCRIPTION

Referring first to FIGS. 1 and 2, the tube is extruded from a die (not shown) into a quench tube 10 located in a block 12 connected to the extrusion press by suitable means such as tie rods 14. The tube is extruded at high speed as for example up to 2000 feet per minute. The tube is extruded from a billet which may have a temperature sufficiently high to produce oxidation and scaling of the extruded tube unless steps are taken to prevent it.

The extruded tube passes through the quench tube 10, details of which are best seen in FIG. 4. The tube has its end adjacent the extrusion press flared as indicated at 16. In addition, it is provided with a multiplicity of spray nozzles connected to a water inlet conduit 18 and manifold tubes 20. The nozzles adjacent the inlet end of the tube 10 are inclined away from the end. A similar inclination is given to the next set of nozzles 24. The arrangement is such that the spray is thus directed longitudinally of the quench tube 10 and neither water nor gas can escape in significant amounts from the die end. The nozzles indicated at 26 are directed radially, and the nozzles indicated at 28 are directed toward the die end of the tube. With this arrangement the extruded tube enters immediately into a spray or substantially solid water environment in which it is initially cooled and which prevents oxidation.

The extruded tube passes from the quench tube 10 through a suitable seal 30 into the end of an elongated guide tube or runout chamber 32. As best seen in FIG. 5, the guide tube 32 comprises at its top a generally semicylindrical wall 34 and is provided with a downwardly and inwardly inclined flat wall 36. The enclosure is completed by an elongated hinged door 38 which is pivoted as indicated at 40 to one edge of the wall 34. Suitable actuating means such as piston and cylinder devices 41 are provided to effect swinging movement of the hinged door 38. The wall 36 and the door 38 are provided on their inner surfaces with flat wear plates 42 which engage an extruded tube designated at T in this figure. Since this tube engages the two inclined wear plates 42, it is guided into perfectly straight condition. The angularity between the wear plates 42 is somewhat in excess of 90°, as for example 100°. This angularity avoids development of wedging forces between the surface of the tube and the guide plate while at
the same time being sufficient to insure straightness of the tube.

The guide tube 32 is provided throughout its considerable length with a multiplicity of spray nozzles 64. As best seen in FIG. 3, a plurality of conduits are provided such for example as an air conduit 46, a steam conduit 48, and a water conduit 50. Each of the conduits will connect to a plurality of sets of nozzles, the nozzles of each set being provided in accurately spaced relation as indicated in FIG. 5. With this arrangement the nozzles connected to the water conduit 50 may be set to produce a fog or mist of water. The steam nozzles will normally be operated just prior to each extrusion operation to provide a steam environment and to eliminate air from the tube to prevent tube scaling or oxidation. The air conduit 46 may if desired, be connected to a suitable inert gas if such would be preferred to steam. Sets of water nozzles may be provided at 3-foot intervals.

The tube 32, as best indicated in FIG. 3, is supported by a plurality of plates 52 provided with roller supports 54 suspending the entire construction from longitudinally extending rails 58, the latter being supported by spaced columns 58. Suitable means (not shown) is provided connected to the tube 32 and supporting structure to effect longitudinal movement of the tube 32 so as to move the end thereof adjacent the die away from the outlet end of the quench tube 10. With this arrangement, after the tube has been extruded into the guide tube 32, when the quench tube is moved away from the quench tube the end of the extruded tube is moved out of the quench tube so that the entire tube may move downwardly into the quench tank immediately the door or flaps 38 is swung to open position.

When the tubes drop from the guide tube 32 they roll down an inclined surface 60 and into a quench tank 62 which extends the full length of the guide tube and which is provided at intervals with V-shaped supporting brackets 64 into which the extruded tube rolls. Adjacent the quench tube 62 is a table diagrammatically indicated at 66 onto which the tubes are lifted from the quench tank by mechanism subsequently to be described. The table is inclined to slope downwardly and away from the end thereof adjacent the extrusion die. This is for the purpose of causing water drawn into the interior of the extruded tubes to drain out of the lower end thereof. In addition to being inclined as aforesaid, the surface of the table is waxed and diagrammatically indicated in FIG. 6, the line 68 indicating the elevation of the edge of the table adjacent the die, and the line 70 representing the elevation of the table at its opposite end. The length of the lines 72 indicate the difference in height between the elevated and lower end of the table and it will be observed that intermediate its ends a maximum inclina-

The extruded tubes are lifted from the quench tank 62 by lift arms 70 which are of varying length and each of which is connected to a crank 80, all of the cranks being of the same length. The arms 70 at their free ends carry tube lifting rollers 82 which are formed of a soft material to avoid damage to the tubes. A material suitable for this purpose is neoprene.

Referring to FIG. 7, it will be observed that the lift arms 70, here individually designated 78a, 78b and 78c, are of different lengths and are connected to pivot mountings for support shafts 84 which are spaced different distances above the quench tank 62 by differently dimensioned spacers 86. The crank arms 80 however, are all of the same length and the axes of the shafts 84 occupy a single inclined line 88. Crank arms 80 are interconnected by links or a single link 90, operated by a driving crank (not shown). This arrangement is such that the rollers 82 move upwardly beneath a tube supported on the brackets 64 different distances so as to elevate the tube and at the same time to incline it downwardly away from the end adjacent the die. The tube lifted by the rollers 82 is raised to position above the arms 92. The arms are pivoted to permit swinging movement thereof as the tube moves upwardly past the inclined surface. As the rollers 82 thereafter move downwardly the tube engages the upper surface of the arms or rails 92 and rolls down to a first position on the table 66 corresponding to a tube position designated Ta.

The system is designed for use with copper tubes or copper alloy tubes and preferably, copper alloy tubes are fed to the right by inclined pivot arms 92a where they roll down a ramp 93 and may be discharged one at a time or continuously. The arms 92 are intended for use with copper tubing. It will be understood that when the arms 92 are employed to shift copper tubes to the left as viewed in FIG. 6, the arms 92a are swung about their pivot axes to inoperative position.

The table 66 is provided with two separate walking beam systems one of which is diagrammatically indicated at 94 and the other at 96. These walking beam systems include bars 98 and 100 respectively, which are moved in a circular path as is conventional in walking beams, and advance the tubes laterally in a step-by-step manner as for example 6 inches at each step. The two walking beam systems are independent of each other so that tubes may be removed from the quench tank and advanced halfway across the table before reaching the section operated on by the walking beams.

Referring again to FIG. 6, adjacent to the end of the table corresponding to the maximum inclination of tubes as indicated by the line 74, an air nozzle connection diagrammatically indicated at 102 is provided which is moved automatically into registration with the elevated end of the tube thereat, and a blast of air directed through the tube to eliminate any retained water therein. At another station, diagrammatically indicated at 104, a tube pointing device is brought into coaction with the adjacent end of the tube at the associated station so as to reduce the diameter of the tube to permit it to be inserted through a draw die. Intermediate the nozzle 102 and the tube pointer 104 a charge of lubricant is introduced into the tube and a plug is inserted for coaction with the draw die.

Thereafter, the tubes are advanced step-by-step by the second walking beam section including bars 98 until the tubes reach a feed trough 106 which preferably is lined with hard wood. A pair of feed rolls 108 project through opposite sides of the feed trough to engage a tube therein and are effective when energized to feed the tube, which at this time has been cleared of water, furnished with lubricant for drawing, has a draw plug inserted therein, and has been pointed into coaction with a draw die for connection to a bull block.

In order to provide for connection of the pointed end of the tube with the draw die and bull block, a section 110 of the trough, as for example 20 feet, is pivoted as indicated at 112 so that the end of the trough may be swung to the position indicated at 114 in alignment with a draw die.

The end portion of the guide tube 32 adjacent the quench tube 10 is provided with a short discharge flap which may be opened during the piercing of a billet preceding the next extrusion operation. The piercing operation will include movement of the heated billet to extrusion position and corresponding discharge of the slag remaining in the extrusion press after completion of the preceding extruding operation. An inclined guide chute 116 is provided down which the discharged slag moves to a slug basket 118. Thereafter, the flap is immediately closed so that during initiation of the following extrusion operation, the end of the extruded tube will pass beyond the flap into the main portion of the guide tube.

With the foregoing general description of the apparatus in mind, the operation will be described with some attention given to exemplary dimensions and conditions.

In the first place, the system is adapted to receive the hot extruded tube just as it leaves the extrusion die so that it is not subjected to oxidizing or scaling conditions. The copper tubing may have an extruded temperature of approximately
This tube will enter the quench tube, preferably made of stainless steel, and move through it at relatively high velocity, as for example 2000 feet per minute. The quench tube may have a length of approximately 5 feet. A high volume flow of water is provided in this quench tube through the multiplicity of nozzles, approximately 250 gallons per minute being supplied in a typical example at a pressure of 150 p.s.i.

As described in the description of the apparatus, the arrangement of nozzles and particularly their directions, insures that neither water nor gas can escape at the die end of the quench tube in significant amounts and that a minimum amount of air will be drawn into the tube. As the tube passes beyond the quench tube it enters a totally enclosed continuous stainless steel guide tube. The bottom wall of this guide tube is formed of flat inclined surfaces defining a V having an included angle of somewhat more than 90° which is effective to guide the tube accurately and to maintain it in perfectly straight condition while at the same time avoiding any surface injury to it. As the extruded tube advances along the guide tube, spray nozzles positioned approximately every 3 feet throughout the length of the guide tube, are operable to spray a large volume of water onto the tube. For example, the nozzles may spray 400 gallons per minute of water at a pressure of 150 p.s.i., the nozzles being adjusted to produce a mist or fog. Prior to entry of the extruded tube into the guide tube, steam will be injected into the tube through the steam nozzles, thus eliminating air and effectively preventing oxidation of the tube.

Normally the discharge flap formed by one of the inclined bottom walls of the guide tube is substantially closed but left with a small opening sufficient to drain all water from the guide tube. If desired, the discharge flap may be closed and a weir provided at the outer end of the guide tube so that the tube may be extruded under water.

When the extrusion has been completed and the extruded tube severed from the slug in the die press, the guide tube will be moved longitudinally on the rails 56 away from the extrusion die, as for example approximately 20 feet. The discharge flap will be caused to open from 0 to 30 seconds after the guide tube has been fully retracted to discharge the extruded tube into the quench tank. The flap is then closed and the guide tube moved back along the rail into extrusion position.

The quench water provided in the quench tank normally contains a small percentage of water soluble oil. The level of water in the quench tank is controlled by an adjustable weir. The water is circulated and maintained by a suitable heat exchange system to a temperature normally between 110 and 120°F.

The operation of the lift-out arm is timed so as to leave the tubes in the tank for whatever time is required to complete the quench operation, normally from 5 to 50 seconds after discharge into the tank. In the operation of the rotary lift arm, the individual tubes are not only elevated into inclined position as previously described, but, due to the arcuate path of movement, they are moved an additional 3 feet away from the press.

In the elevated position on the table the inclination of the tube is approximately 1 foot in 110 feet to start the water draining from the tube. The lift rolls 82 are preferably formed of 60 Durometer (Shore) hardness material to avoid marking of the tube. It will be observed that the operating mechanism for the lift arms 78 is all located exteriorly of the quench tank.

In a typical operation the copper tube discharged to the walking beam-type table is advanced by increments of 6 inches transversely of the tube. When the tubes have reached the intermediate portion of the table where the inclination is approximately the greatest, the air blowout and pointing mechanism will move into operative relation with the adjacent ends of the tubes, which remain stationary at this time. The inclination of the extruded tubes at approximately the pointing station is 1 foot in 55 feet.

As the tube moves in a step-by-step manner past the intermediate portion of the table, it is engaged with the air blowout mechanism to expel any remaining water therefrom. In addition, at the pointer station the mechanism will dimple the tube, inject a measured quantity of lubricant into the tube, insert a draw plug from an adjacent magazine, and point the tube or reduce its diameter to permit insertion through the die.

The extruded tube eventually drops into the feed trough 106, preferably lined with hard wood to prevent injury to the surface of the tube. The pinch rolls diagrammatically illustrated at 108, are operated to feed the tube longitudinally of the feed trough. The bull block end of the feed trough will be pinned to the horizontally traversing die box so that a 20 foot section of the trough is free to pivot as the die box traverses.

Among the quality specifications which are obtained by the operation of the apparatus as described in the foregoing are the following: The extrusion runout system is capable of consistently providing an extruded tube free from visible oxidation after quenching.

The system also consistently provides an extruded tube to the breakdown bull block that is free from injurious mechanical defects such as nicks, scratches and abrasions.

The system is further capable of consistently providing an extruded tube that is straight enough to be conveyed from the extrusion press runout system to the breakdown bull block automatically without any unusual difficulty and without encountering damage to the tube.

The system is fully automatic in operation and in general, all operations will be initiated by initiation of the extrusion press cycle. Inasmuch as the tube supporting table is divided into two sections, cycling dependent upon extrusions may to a considerable extent be independent of cycling as determined by the capacity of the ensuing tube drawing apparatus.

We claim:

1. A tube extrusion press runout and tube handling system comprising a relatively short stationary quench tube having an inlet end positioned directly adjacent an extrusion die to receive hot base tubes as they are extruded from the die, spray nozzles directed radially inwardly of said quench tube, an elongated enclosed runout guide tube or chamber having an open inlet end directly adjacent the outlet end of said quench tube, spray nozzles distributed along said guide tube, an elongated quench tank adjacent and parallel to said guide tube, and means for transferring tubes from said guide tube to said tank, a table extending along said tank, means for transferring extruded tubes from said tank to said table, a table of said table, a feed trough at the side of said table toward which tubes are advanced, a tube blowout and pointing station between the sides of said table, and means associated with said feed trough for advancing the pointed ends of tubes into a draw die for connection to a bull block.

2. A system as defined in claim 1 in which said runout guide tube or chamber is horizontal and has downwardly and inwardly inclining bottom walls effective to guide the extruded tubing into straight condition.

3. A system as defined in claim 2 in which the bottom walls are equally inclined from the vertical and have an included angle therebetwne in excess of 90°.

4. A system as defined in claim 2 in which one of said bottom walls is hinged throughout its length to open throughout its length and to drop the straight tube as a unit into the quench tank.

5. A system as defined in claim 1 in which the quench tank is provided with a multiplicity of supports spaced longitudinally thereof in horizontal alignment to support the tubing in quenching water in straight condition.

6. A system as defined in claim 5, and in which the means for transferring the tubing from the quench tank to the table comprises crank arms having tube supports at the ends thereof, said arms being of progressively varying length mounted on pivot axes disposed along a line inclined from the horizontal to incline the tubing as it is lifted from the tank.
7. A system as defined in claim 6 comprising means for transferring the tubing from the crank arms to the table, said means comprising inclined pivotally mounted rails which pivot out of the way as the tubing is lifted past them but which retain the tubing as the tube supports on said crank arms move downwardly past said rails.

8. A system as defined in claim 1 in which the means for transferring tubes transversely of said table comprise separately operable systems to advance tubes at one side of the table toward the center of the table and to advance tubes at the other side of the table away from the center thereof.

9. A system as defined in claim 2 in which said feed trough is straight and includes an elongated pivoted straight end section which provides for guiding the pointed tube end toward a draw die station.

10. The method of treating tubing in a continuous process intermediate an extrusion die and a draw die which comprises advancing the tubing immediately upon extrusion while at extrusion temperature through a high volume quenching spray while substantially preventing contact with air, straightening the tubing by advancing the tubing further into a horizontal runout chamber having downwardly and inwardly converging bottom walls defining a straight line support which supports the tubing in straight condition, releasing the tubing simultaneously throughout its length and providing for gravity movement thereof onto a multiplicity of longitudinally spaced tube supports in a body of water, retaining the tubing in the quench water until quenching is completed, lifting the tubing at a multiplicity of points to maintain the tube in straight condition, while inclining the tubing uniformly throughout its length to maintain its straight condition, advancing the tubing laterally step-by-step while maintaining its inclined straight condition, intermediate successive lateral advances applying air pressure to the elevated end of the tubing to expel water therefrom, inserting a floating mandrel and an internal tube lubricant, and pointing the end of the tubing, depositing the tubing in a feed trough having a nonmetallic lining to prevent marring the tubing, and advancing the tubing pointed end foremost to bring the pointed end into proximity to a draw die.

11. The method as defined in claim 10 which comprises spraying the tubing with water as it is advanced into the runout chamber.

12. The method as defined in claim 10 which comprises providing a gradual inclination of an elongated portion of the trough to align the pointed end of the tubing with the space occupied by a draw die.

13. The method as defined in claim 10 in which said tubing is supported on an inclined table intermediate the steps of lateral advancement.

14. The method as defined in claim 13 which comprises laterally advancing a multiplicity of sections of tubing simultaneously.

15. The method as defined in claim 14 which comprises laterally advancing a multiplicity of sections of tubing at one side of the table simultaneously toward the center of the table, and advancing a multiplicity of sections of tubing simultaneously away from the center of the table independently of the advancement of tubing toward the center of the table.