Jan. 22, 1957 C. PASQUALE 2,778,285

MACHINE FOR MANUFACTURING WELDLESS ASBESTOS-CEMENT PIPES

Filed Aug. 31, 1954 5 Sheets-Sheet 1

FIG. 1

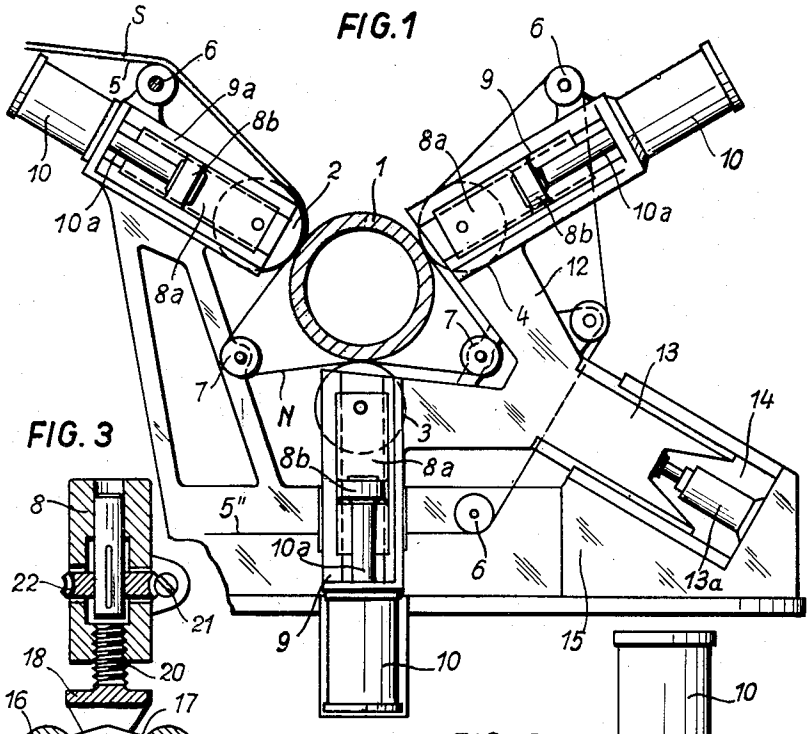


FIG. 3

FIG. 2

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FIG. 4

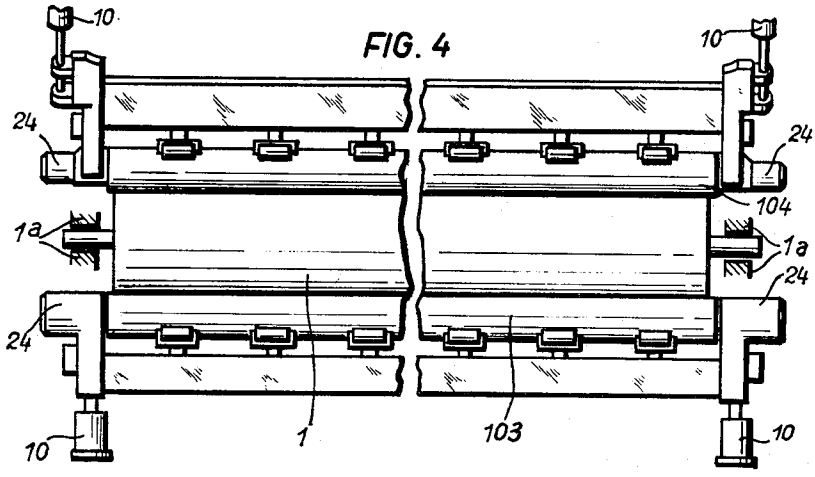


FIG. 5

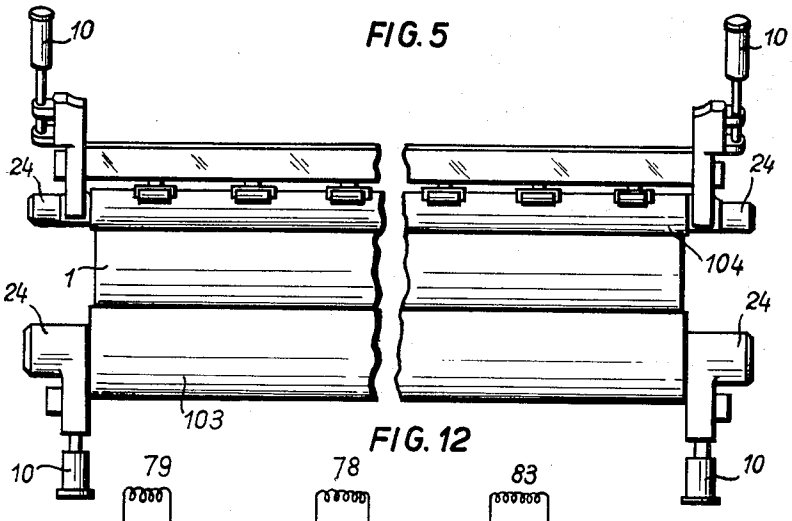
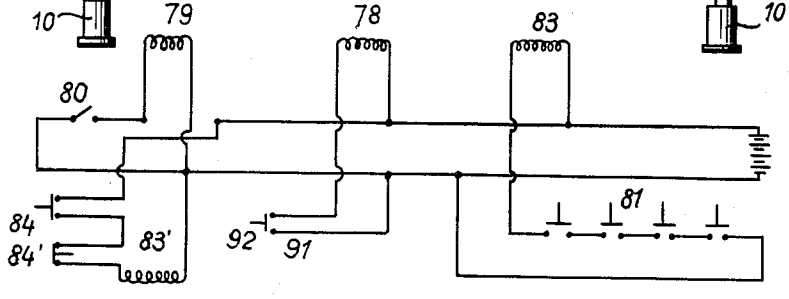


FIG. 12



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FIG. 8

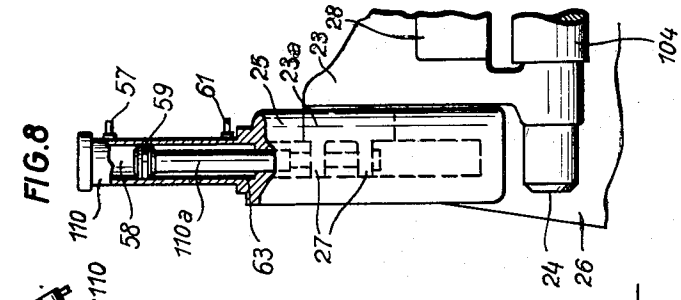
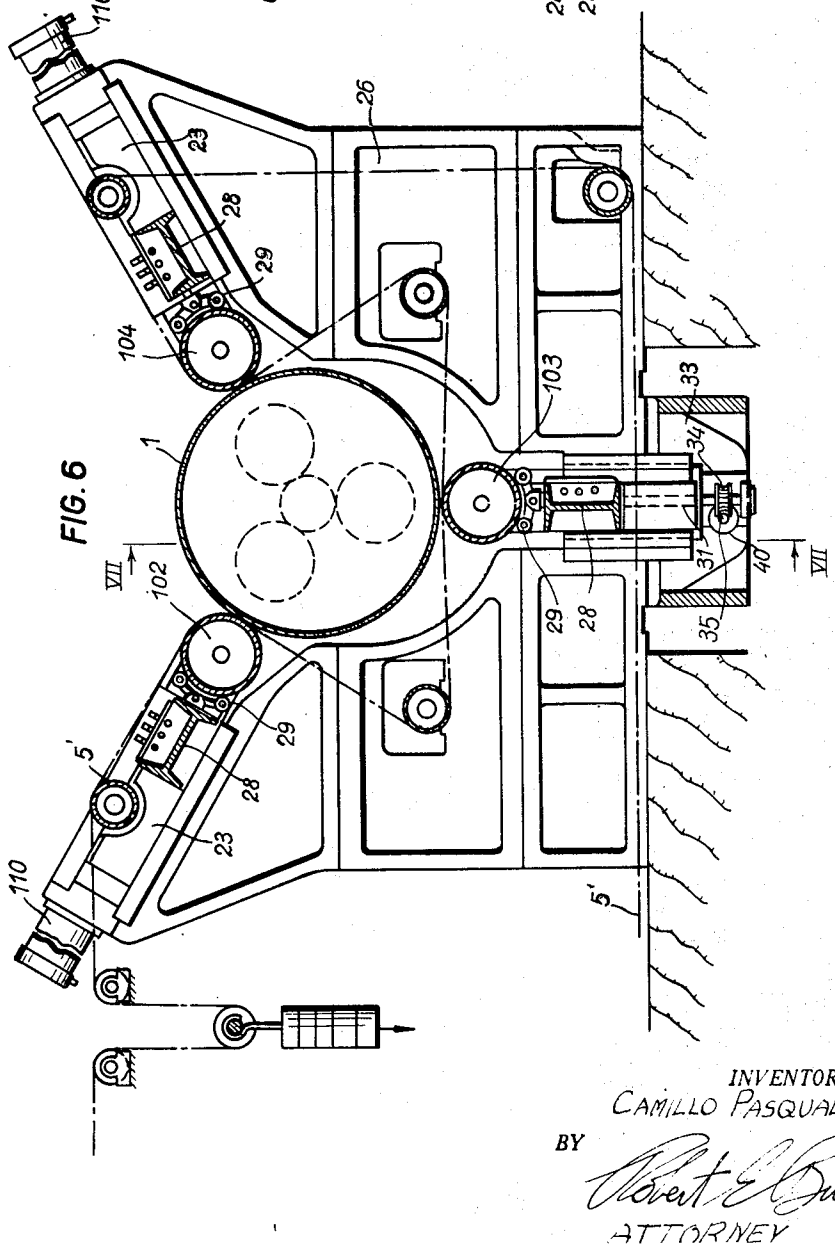


FIG. 6



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FIG. 7

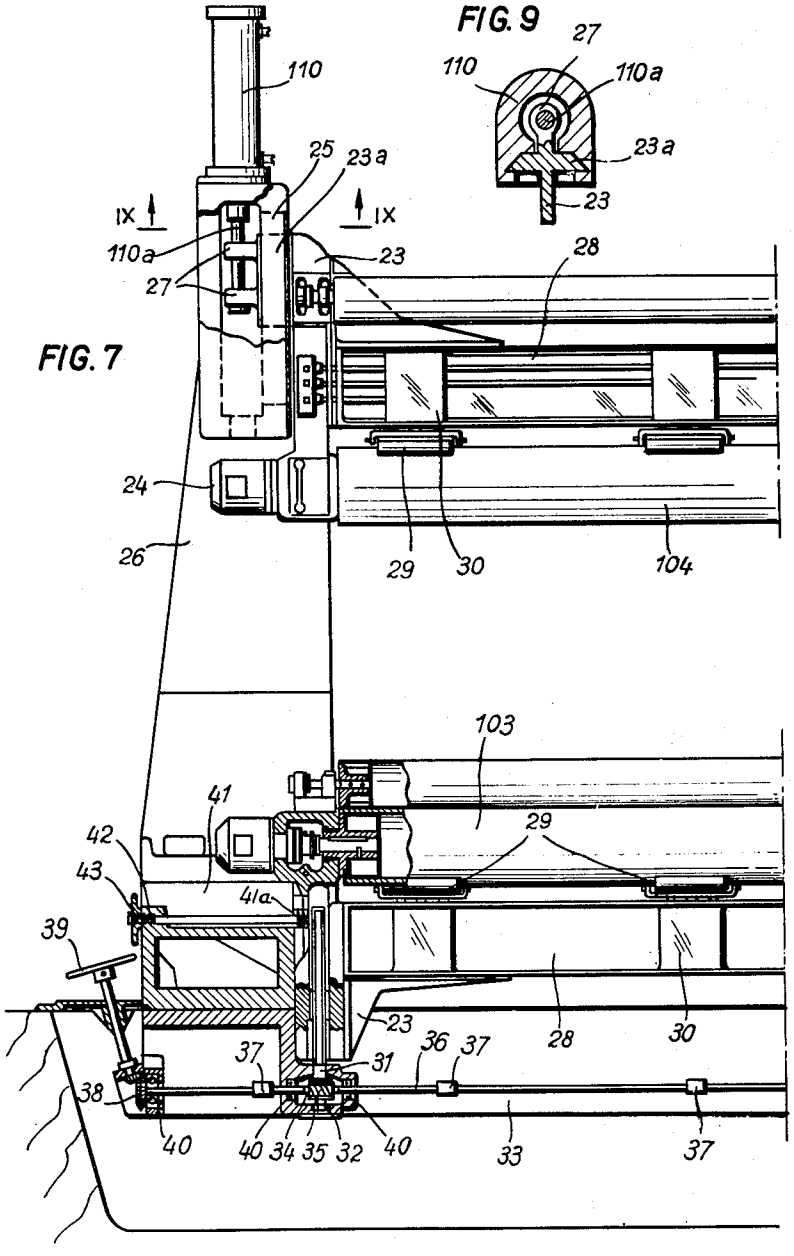


FIG. 9

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FIG. 10

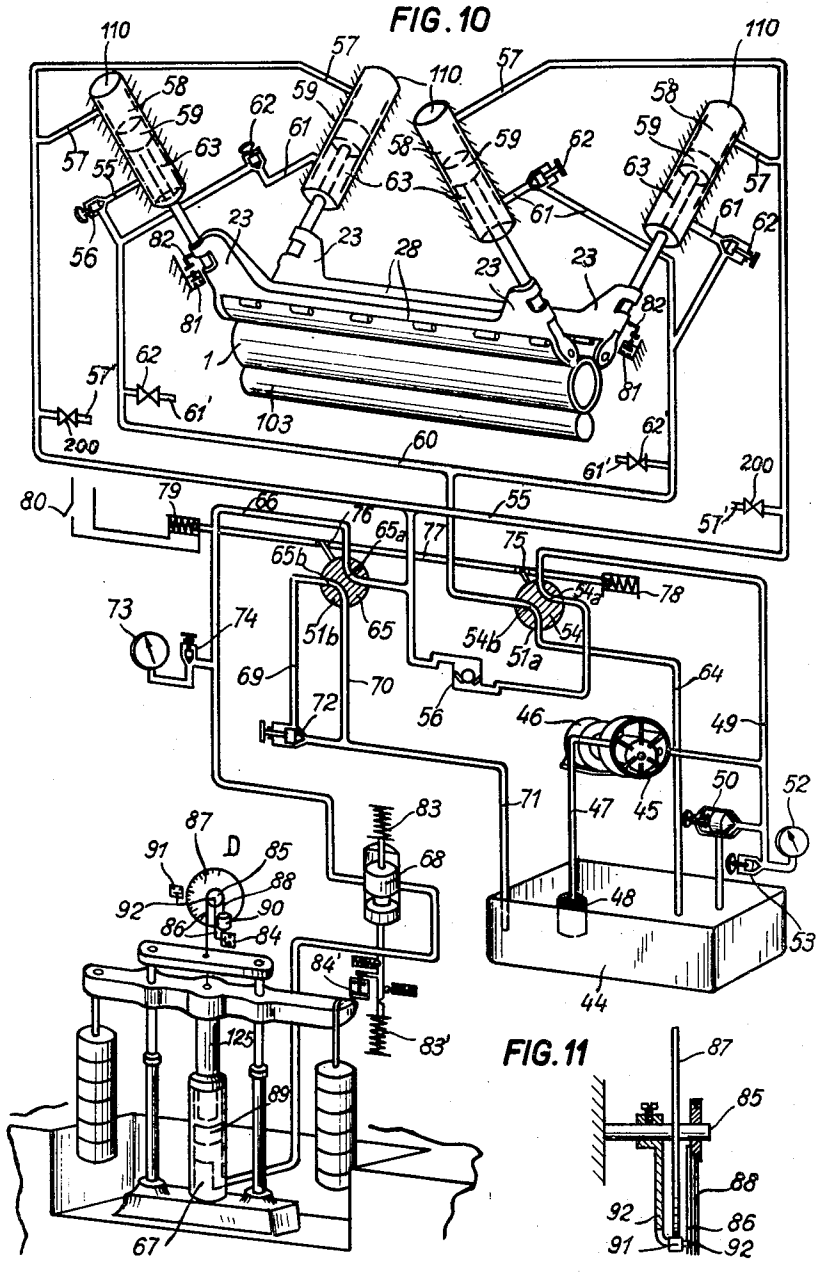


FIG. 11

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2,778,285

MACHINE FOR MANUFACTURING WELDLESS ASBESTOS-CEMENT PIPES

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Application August 31, 1954, Serial No. 453,275

Claims priority, application Italy September 1, 1953

6 Claims. (Cl. 92—66)

This invention relates to a machine for manufacturing weldless asbestos-cement pipes from a continuous asbestos-cement web, wherein a mandrel is provided for winding an asbestos-cement web which is subjected during operation of the machine to the pressure of a set of pressure cylinders tangential to its outer periphery.

An object of this invention is to provide an improved machine of the abovementioned type, wherein the pressure cylinders exert on the mandrel during formation of the asbestos-cement pipe a substantially constant high pressure, in order to confer to the asbestos-cement pipe being formed the greatest possible compactness and a uniform thickness which result in a high strength of the pipe against internal pressure and stresses during handling and transportation, whereby the field of use of the pipes can be considerably extended.

A further object of this invention is to provide a machine for manufacturing weldless asbestos-cement pipes, which is simple in construction, of small size and easy to use even by unqualified staff, in order to reduce the cost of installation, maintenance and operation of the equipment for manufacturing asbestos-cement pipes.

A further object of this invention is to provide a machine of the type described, in which the component parts of the machine are arranged in such manner as to facilitate charging of the mandrel on the machine on starting of manufacture, and discharge of the mandrel together with the pipe formed thereon on completion of manufacture.

A further object of this invention is to provide a machine of the abovementioned type which is suitable for manufacturing asbestos-cement pipes variable in diameter over a wide range, without necessitating replacement of individual members or equipments being a part of the machine.

A further object of this invention is to provide a machine of the type above referred to provided with hydraulic and electric means cooperating together in order to make the operation of the machine at least in part automatic and substantially reduce the number of attendants essential for operating the machine.

These and further objects of this invention will be clearly understood from the following description referring to the accompanying drawings which show some constructions of the improved machine, and wherein:

Figure 1 is a diagrammatic side view of the machine,

Figure 2 is a part-sectional side view of a detail of the machine, shown on an enlarged scale,

Figure 3 is a sectional view on line III—III of Figure 2,

Figure 4 is a diagrammatic side view of a modification,

Figure 5 is a similar view of a further modification,

Figure 6 is a cross sectional view of a further modification,

Figure 7 is a longitudinal fragmentary section of the machine on line VII—VII of Figure 6,

Figure 8 is a sectional view of a detail of the embodiment shown in Figure 6,

Figure 9 is a sectional view on line IX—IX of Figure 7,

Figure 10 is a diagrammatic view of the hydraulic circuit and electric means associated therewith adapted to effect the displacement of the pressure cylinders of the machine,

Figure 11 is a sectional view of a constructional detail of one of the mechanisms shown in Figure 9,

Figure 12 is a wiring diagram of the electric circuit cooperating with the hydraulic circuit shown in Figure 10.

On the drawings, Figures 1 to 3, **1** denotes the mandrel about which the asbestos-cement pipe is formed through the continuous rotation of the mandrel **1**, by winding thereabout a continuous asbestos-cement web fed by the upper run **5** of an endless belt conveyor. Three pressure cylinders **2, 3, 4** are arranged around the mandrel, their axes being parallel with one another and situated at equal angular intervals of 120°.

The conveyor belt N made of fabric, but preferably of felt, travels continuously between the mandrel and pressure cylinders **2, 3, 4** and is conveniently guided by rollers **6** and **7**, the latter arranged between the pressure cylinders **2—3** and **3—4**, respectively. The upper run **5** of the conveyor delivers the layer S of asbestos-cement slurry in the form of a continuous web equalling in width the length of the pressure cylinders from the mandrel **1**. The belt N places the layer S of slurry at the periphery of the mandrel **1** at the region of contact between the mandrel and pressure cylinder **2**, then travels further successively through the regions of contact of the pressure cylinders **3** and **4** with the mandrel **1**, preventing the layer deposited on the mandrel from being removed by said pressure cylinders **3** and **4**. The belt leaving the region of contact between the pressure cylinder **4** and mandrel **1** is deflected by rollers **6** and travels along the lower or return run **5″** of the conveyor.

Each of the pressure cylinders is carried by a cross member or beam **8** arranged parallel with its axis (see Figure 2) and provided at its opposite ends with two shoes **8*a*** slidable in two parallel guideways **9*a*** each provided in a structure **9**. Each structure has rigidly fixed thereto a double-acting hydraulic ram **10**, of which the stem **10*a*** is secured to the extension **8*b*** on its respective shoe. Each pressure cylinder carries at its end an axial pin **11** rotatably mounted in a bearing **8*c*** carried by the cross member **8**. Consequently, each cross member **8** is displaceable together with its respective pressure cylinder with respect to the structures **9** arranged on opposite sides of the machine, under the action of a pair of hydraulic rams **10**.

The structures **9** carrying the pressure cylinders **3, 4** are supported on each side of the machine by an auxiliary frame **12** having a shoe **13** slidably mounted within a guideway formed in the stationary machine frame **15**. The guideways **14** are of such shape that the auxiliary frames **12** are displaceable towards and away from the operative position of the equipment shown in Figure 1.

These movements of the auxiliary frames are controlled by double-acting hydraulic rams **13*a*** each interposed between the shoe **13** of the auxiliary frame **12** and machine frame **15**.

The structures **9** supporting the pressure cylinder **2** are fast with the machine frame and their respective hydraulic rams can therefore merely effect displacements of their respective cross member **8** and pressure cylinder **2** as may be found necessary during formation of the asbestos-cement pipe on the mandrel **1** for gradually suiting the growing thickness of the pipe being formed.

The position of the pairs of structures **9** and guideways **9*a*** formed therein at opposite ends of the machine frame, as well as the arrangement of the bearings **8*c*** with respect to the cross members **8** is such that the three pressure cylinders **2, 3** and **4** move under the action of their

respective pairs of hydraulic rams **10**, maintaining their axes constantly parallel with one another and situated in three planes intersecting one another along a straight line.

The pressure cylinders **2**, **3**, **4** are evenly pressed against the periphery of the mandrel or pipe being formed throughout their length by pairs of rollers **16** distributed over the length of the pressure cylinders. The latter are carried by pairs of beams **17** (see Figures 2 and 3) rocking about supporting members **18** provided with guide pins **19** slidable in slideways formed in the cross members **8** and adapted to be pushed by a central screw **20** having its seating cut in the cross member **8** and driven by sets of gearings comprising endless screws **21** and worm wheels **22** fast with the screws **20**. Control of the screw **20** is effected by acting by means of suitable spanners on the heads **21***a* of each endless screw, said heads projecting from the ends of the cross members **8**.

Each pair of rollers **16** is therefore provided with an independent control, which may be acted upon for increasing pressure at any desired region on the pressure cylinders.

The mandrel **1** is fitted in its operative position and the pipe formed thereabout is finally removed therefrom in a longitudinal or vertical direction by conveniently removing from their operative position the movable pressure cylinders **3** and **4** by acting on the control for the hydraulic ram **13***a*.

Of course, the invention is not limited to the structure shown in Figure 1. So, for instance, the auxiliary frame **12** may be fast with the machine frame **15**, so that the units comprising structures **9** and double-acting hydraulic rams associated with their respective pressure cylinders are constantly maintained in their operative position shown in Figure 1.

All the double-acting hydraulic rams **10** can be connected through the interposition of the necessary control members to a constant pressure source, so that the pressures by the pressure cylinders **2**, **3**, **4** on the periphery of the pipe being formed are maintained constant all the time the pipe is being formed till said pipe reaches its desired thickness.

In the embodiment shown in Figure 1 the mandrel bears by its weight on the lower pressure cylinder **3**. Therefore, the hydraulic ram **10** should be such as to counteract the increasing weight of the mandrel **1** as well as the weight of its respective cross member **8** and associated mechanisms.

However, the mandrel **1** can be supported at its ends in stationary supports **1***a* arranged in such manner that the mandrel axis constantly coincides with the straight line of intersection of the planes in which the axes of the pressure cylinders **2**, **3** and **4** (Figure 4) are displaceable.

An arrangement of this type may be found convenient on account of the fact that it permits of relieving the hydraulic rams **10** associated with the pressure cylinder **3** of the weight of the mandrel and pipe being formed, as well as to render the pressure at the regions of contact between the pressure cylinders **2**, **3**, **4** and the periphery of the pipe being formed constant as well as thoroughly uniform during the whole pipe forming step.

Rotation of the mandrel at the start of the pipe forming step and its successive rotation together with the pipe thereon is derived by friction from the displacements of the belt conveying on its upper run the endless asbestos-cement web, which is in turn fed by the rotation of the pressure cylinders **2**, **3** and **4** driven by suitable motor means which will be described hereafter.

It will be obvious that by the structure shown in Figure 1 the axis of the mandrel and pipe being formed would coincide with the axis of intersection of the planes within which the pressure cylinders **2**, **3** and **4** move at the start only of the step of forming the asbestos-cement pipe. At the end of this step the axis of the mandrel, hence of the formed pipe would be displaced upward to the above-

mentioned straight line of intersection by an extent equalling the wall thickness of the pipe. The initially radial pressure exerted by the pressure cylinders **2** and **4** would no longer be so at the end of the pipe forming cycle.

This drawback could be obviated by making the control of the hydraulic rams **10** supporting the pressure cylinder **3** independent and arranging said pressure cylinder at a height such as to displace the axis of the mandrel on which the pipe shall be formed downward with respect to the straight line of intersection of the planes within which all the pressure cylinders are moved by an extent equalling the thickness of the pipe to be formed. By blocking means of a suitable control the ram **10** supporting the pressure cylinder **3** as the pipe is being formed about the mandrel **1** the axis of the latter will be moved upward till the end of the pipe forming step, when said axis takes a position such that the pressure by the cylinders **2** and **4** on the periphery of the formed tube is accurately radial.

The large weight of the component parts sliding under the action of the pairs of hydraulic rams **10**, more particularly the unit comprising the lower cylinder **3** could make the cross member **8** superfluous. In this case, however, it is advisable to make the lower pressure cylinder **3** large enough in diameter to minimize bending. A structure of this kind is clearly shown in Figure 5.

A construction in which the displacements of the lower pressure cylinder, instead of being effected by a hydraulic ram are effected by hand is shown in Figures 6 and 7.

The structure and operation of this machine are substantially similar to those of the machine diagrammatically shown in Figure 1.

The pressure cylinders **102**, **103**, **104** are each rotatably supported at their ends by structures **23** and are driven by two synchronized electric motor-reducing gear units **24** supported at the lower end of each of said structures. Each structure **23** is provided with shoes **23***a* sliding in a guide-way **25** formed in the frame of one of the two opposed headers **26** of the machine. The extensions **27** on the shoes **23***a* are secured to the stems **110***a* (Fig. 8) of the pistons **59** movable in the hydraulic rams **110** arranged with their axes parallel with the planes of said guide-ways **25** so that the displacements of the axes of the pressure cylinders **102**, **103**, **104** take place in the planes intersecting one another along a common straight line.

Cross members **28** made from double **T** shapes are secured to the pairs of structures **23** sliding by means of their shoes in suitable guide-ways formed in the opposed headers **26** of the machine frame. **29** denotes the pairs of rollers interposed between the cross members **28** and peripheries of the pressure cylinders for keeping them against elastic deformation. The displacements of the pairs of rollers **29** are effected in a substantially similar manner as described with reference to Figures 2 and 3, but for the fact that their mechanisms are enclosed in cases **30** fitted to one side of the shapes **28**. The structures **23** supporting the lower pressure cylinder **103** slide through their shoes in the lower guide-ways **25** and are each supported by a screw-threaded spindle **31** screwed into a suitable vertical tapped seating formed in the structure **23**.

The spindles **31** are each supported at their lower end by a thrust bearing **32** resting on the basement **33** of the machine frame and carry a toothed wheel **34** adapted to receive motion from an endless screw **35** keyed on a shaft **36** having universal joints **37** and driven through a bevel gear **38** by a hand-wheel **39**. **40** denotes the bearings supporting the shaft **36** in the machine foundation **33** connecting the two headers **26**.

By operating the hand-wheel **39** the spindle **31** can be rotated in the desired direction and the structures **23**

and their respective lower pressure cylinder **103** can be displaced in a vertical plane.

A vertical position of the pressure cylinder **103** is further safely insured by a lock device comprising a shoe **41** adapted to engage the shoes of the lower structures **23** sliding in their guideways in the headers **26** and supported at the end of a screw-threaded spindle **41***a* screwed into a seating **42** and carrying at its other end a hand-wheel **43**.

The hydraulic circuit and electric means associated therewith which are provided on the machine for effecting the displacements of the pressure cylinders shall now be described.

Referring to Figure 10, **44** denotes a liquid reservoir, preferably containing oil; **45** is a pump which may be driven from an electric motor **46**. The pump inlet connects with a conduit **47** carrying at its lower end a filter **48** submerged in the liquid in the reservoir. The delivery or pressure side of the pump is connected with a conduit **49** which communicates at one end with an adjustable pressure regulating valve **50**, and at its other end with a distributor valve **51***a*. **52** denotes a pressure gauge communicating with the conduit **49** over a cock **53**. **54** denotes the body of the delivery valve **51***a* formed with two internal conduits **54***a* and **54***b*. In the position shown on the drawing the conduit **54***a* connects the conduits **49** with the conduits **55** over a check-valve **56**. Conduit **55** is in communication through connections **57** with the chambers **58** of the hydraulic rams **110** effecting the displacements of the pressure cylinders **102** and **104** which are situated above the pistons **59** moving in said hydraulic rams. The passage **54***b* in the body **54** of the valve **51***a* connects conduit **60**, which is in communication through connections **61** and hand-actuated adjusting valves **62** with the lower chambers **63** in the hydraulic rams **110**, with the outlet conduit **64** leading to the reservoir **44**.

57', **61'** and **62'** denote the connections and adjusting valves therefor for supplying hydraulic rams which may be provided, if desired, for effecting vertical displacements of the lower pressure cylinder **103**. **200** denotes valves adapted to intercept flow of pressure liquid to the chambers in said cylinders, remote from the rods of the cylinder pistons, in order to cut off the inside of said cylinders from the circuit and lock the pistons in any desired position.

51*b* denotes a further delivery valve, of which the inner body **65** is formed with two passages **65***a*, **65***b*. In the valve position shown on the drawing the passage **65***a* connects conduit **55** with a conduit **66** communicating with the inside of the cylinder **67** of a hydraulic accumulator over an electromagnetically operated intercepting valve **68**. The passage **65***b* short-circuits conduits **69** and **70** connected to an outlet conduit **71** leading to the reservoir **44**. **72** denotes an adjusting valve interposed between the conduits **69** and **71**. **73** denotes a pressure gauge connected over a cock **74** to conduit **66**.

75, **76** denotes two levers fast with the bodies **54** and **65** of the distributor valves, hinged to a rod **77** forming by its opposite ends the armatures of two electromagnets **78**, **79** respectively. The winding of the electromagnet **79** can be energised by closing the hand-actuated switch **80**. The winding of the electromagnet **83** is connected in series with switches **81** that are pushed to their closed position by arms **82** fast with the equipments supporting the pressure cylinders, when the latter approach the mandrel **1** (for the sake of clearness only two of said switches are shown in Fig. 10).

Energising of the coil of the electromagnet **83** moves the valve **68** to its position in which it re-establishes communication between conduit **66** and the inside of the cylinder **67** of the hydraulic accumulator. D denotes a control device comprising a pulley **85** rotatably mounted in a stationary support and carrying an indicating arrow **86**. **87** denotes a dial having a peripheral scale calibrated in millimeters thickness of the pipe being formed. A cable **88** is wound on the pulley **85** and has its end attached to the piston **89** of the accumulator, its other end carrying the weight **90**. The switch **84** is so arranged that the pointer **86** causes it to close when it is at the beginning of the scale on the dial denoted by 0. **91** denotes a further normally open switch mounted for oscillation about the axis of the pulley **85** and arranged near the periphery of the dial **87**. The switch **91** can be fixed in any desired angular position to the dial and is connected in the coil circuit of the electromagnet **78** so that it is closed and energises the electromagnet **78** when the end of the pointer **86** abuts the rod **92** connected to the movable switch portion.

The arrangement operates in the following manner; bearing in mind that the diagram shown in Figure 10 relates to the hydraulic circuit at a stage near the end of the approach movement of the pressure cylinders **102** and **104** towards the mandrel, that is, before starting formation of the asbestos-cement pipe.

At the end of the movement of said pressure cylinders towards the mandrel the arms **82** abut the movable portion and close, the electric switches **81**, thereby energising the electromagnet **83** which controls opening of the valve **68**. The cylinder **67** of the hydraulic accumulator is connected to the conduit **66** and chambers **58** of the hydraulic rams **110**. The check valve **56** closes and the pump delivers oil through the calibrated valve **50**. Formation of the asbestos-cement pipe starts under high pressure, said pressure being kept constant till the pipe reaches the desired thickness. On reaching the pipe thickness for which the device D is calibrated, that is, on abutting of the pointer **86** against the rod **92** on switch **91**, the latter closes and energises the electromagnet **78**. This results in displacement of the rod **77** to the right and switching over of the valves **51***a* and **51***b*.

The conduit **49** connected with the delivery side of the pump **45** will be connected with the conduit **60** communicating with the lower chambers **63** of the hydraulic rams **110**. The conduit **55** will be connected to the outlet conduit **71** over the conduit **70**. The movement of the pressure cylinders **102** and **104** away from the surface of the formed pipe starts.

At the same time, the conduit **66** communicating with the cylinder **67** of the hydraulic accumulator is connected over conduit **69** and valve **72** with the outlet conduit **71** leading to the reservoir **44**.

This causes the piston **89** of the accumulator to move downward at a rate governed by the opening of the valve **72**, this movement ending when the pointer **86** of the thickness-indicating device D reaches its 0 position. Abutting of the end of the pointer **86** against the movable portion of the switch **84** results in energising of the electromagnet **83'** which will close the valve **68**. Upon closing this valve opens the switch **84'** provided in series with the switch **84** and the system is ready to repeat the cycle.

In order to start the cycle once more, the external switch **80** should be acted upon for the purpose of energising the electromagnet **79** adapted to return the delivery valves **51***a* and **51***b* to their initial position shown in Figure 10.

The details of the electric circuit will be clearly understood from Figure 12.

What I claim is:

1. In a machine for manufacturing weldless asbestos-cement pipes, a rotatable cylindrical mandrel on which is spirally wound a continuous web of asbestos-cement having a breadth equalling the length of the pipe to be made, a continuous conveyer belt feeding said web to said mandrel, at least one frame, a set of three parallel pressure cylinders, disposed tangentially to said mandrel and having a length at least equal to that of the pipe to be made, said cylinders being displaceable in planes intersecting one another along a straight line parallel with the mandrel and distributed at equal angular intervals about said line, said set comprising a lower cylinder displaceable in a vertical plane and two upper cylinders arranged symmetrically with respect to said plane, each of said cylinders

being supported at its opposite ends by a pair of double-acting hydraulic jacks on the frame, said conveyer belt having an upper run for feeding said continuous asbestos-cement web to the mandrel and a lower return run and travelling successively through the points of tangency between pressure cylinders and the mandrel, the path of the belt between the upper and lower runs of the conveyer being so arranged that the belt successively passes through the point of tangency between the upper pressure cylinder adjacent the upper run of the conveyer and the mandrel, the point of tangence between the lower pressure cylinder and the mandrel and the point of tangence between the other upper pressure cylinder and the mandrel, whereby the mandrel may be introduced and removed from the machine at the top upon removal of the upper pressure cylinders from the surface of the mandrel, means associated with each pressure cylinder for positively driving said pressure cylinders and imparting to them the same peripheral speed for driving the mandrel and said conveyer belt, and means for controlling said hydraulic jacks.

2. In a machine for manufacturing weldless asbestos-cement pipes, the combination as set forth in claim 1, wherein said means for driving said pressure cylinders consists of pairs of electric motors acting respectively on the opposite ends of the respective pressure cylinder.

3. In a machine for manufacturing weldless asbestos-cement pipes the combination as set forth in claim 1, wherein means for manually controlling the position of the lower pressure cylinder in a substantially vertical plane are provided, said means acting independently of the operation of the hydraulic jacks supporting the upper pressure cylinders whereby the axis of rotation of the mandrel is kept in the same relative position to the pressure rollers throughout the winding operation.

4. In a machine for manufacturing weldless asbestos-cement pipes, the combination as set forth in claim 1, wherein the pair of hydraulic jacks supporting one of the upper pressure cylinders is directly carried by the machine frame, and at least one auxiliary frame supporting the jacks which support the ends of the two other pressure cylinders are provided, said auxiliary frame being mounted slidably in said machine frame and movable in a direction parallel to a plane passing through the line of intersection of the planes in which are movable the axes of the pressure cylinders, at least one hydraulic jack operating independently from the jacks supporting the pressure cylinders being interposed between the machine frame and said auxiliary frame.

5. In a machine for manufacturing weldless asbestos-cement pipes as set forth in claim 1, wherein each of the pressure cylinders is rotatably mounted at its ends in bearings provided at opposite ends of a beam parallel to said pressure cylinder and supported at its ends by two hydraulic jacks fast with the machine frame, two rows of aligned parallel rollers spaced axially therebetween and rotatably mounted in supports carried by said beam being also provided, and means for displacing said roller supports to and from said beam independently from one another for exerting a desired pressure between said rollers and said pressure cylinder and preventing its deformation upon operation of the machine.

6. A machine for manufacturing asbestos cement in accordance with claim 1, further including means cooperating with said pressure cylinders and said belt to assure the belt passes only through said points of tangence, said last mentioned means comprising a plurality of guide rollers disposed between the pressure rollers.

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