Nov. 8, 1932. J. R. STRICKLEN ET AL 1,887,251

APPARATUS FOR VULCANIZING RUBBER TIRES, TUBES, AND THE LIKE

Filed Aug. 12, 1931 2 Sheets-Sheet 1

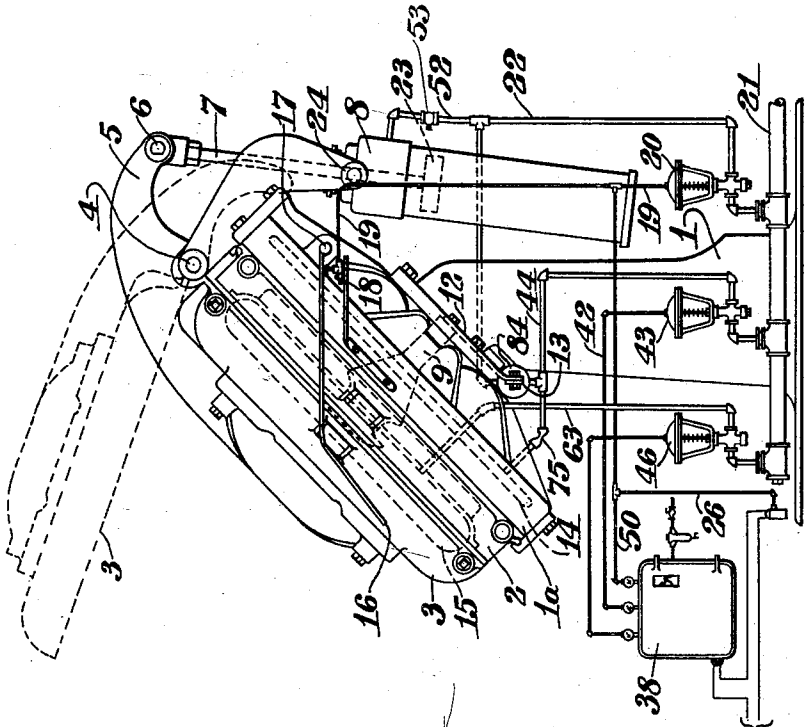


Fig. 2

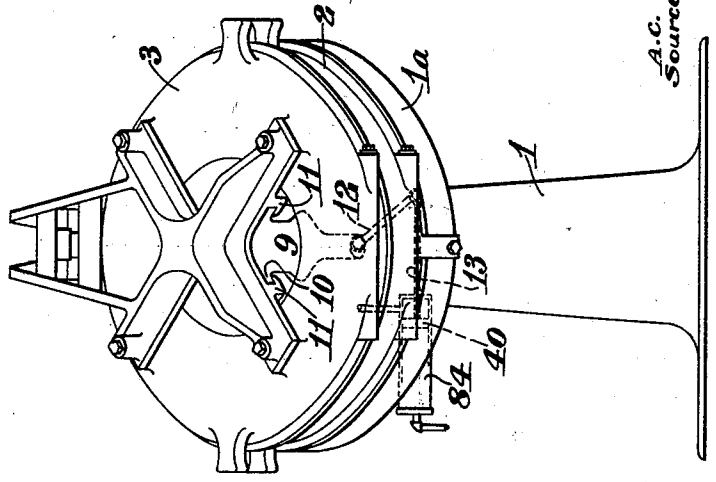


Fig. 1

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Fig. 3

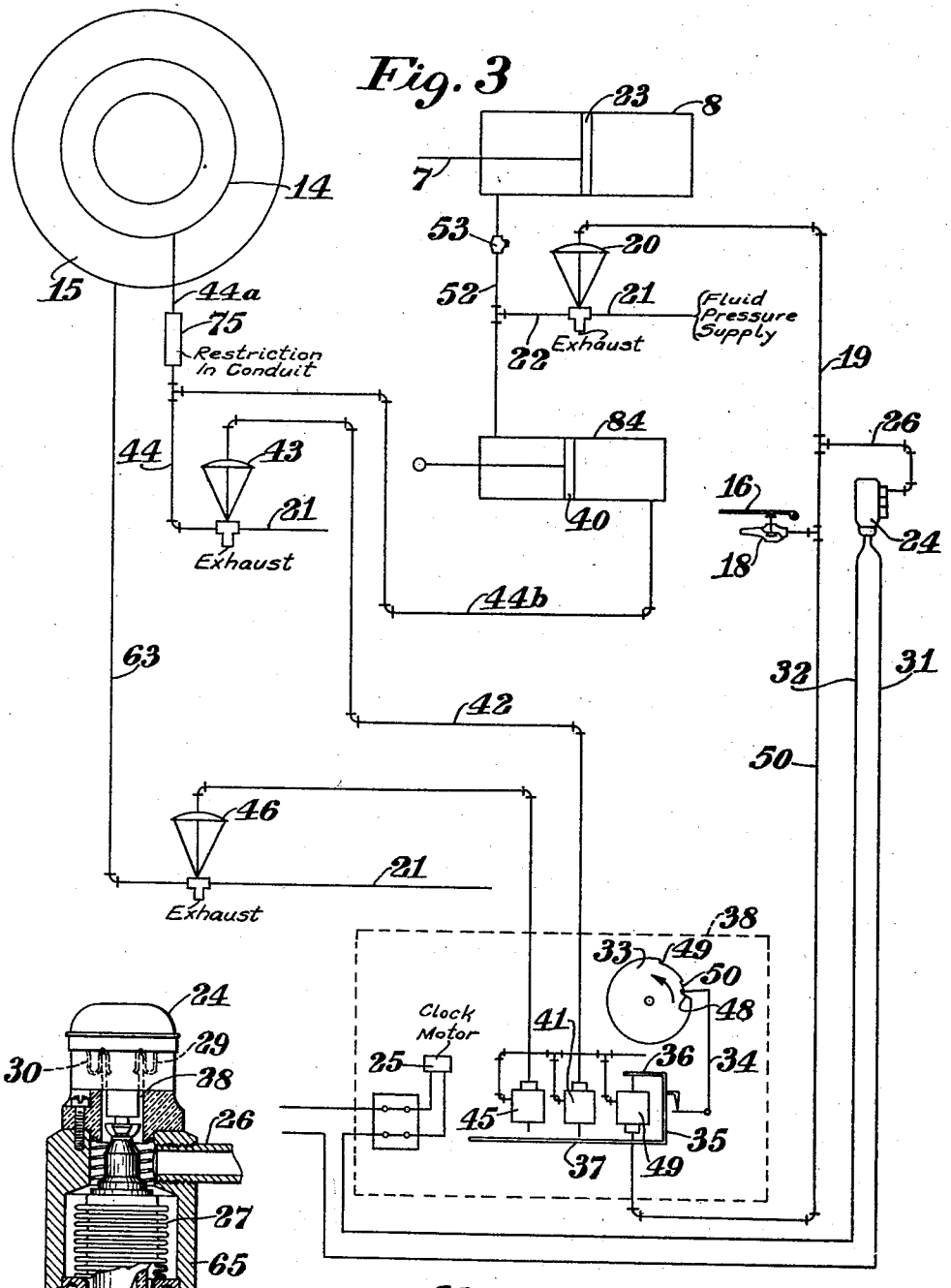


Fig. 4

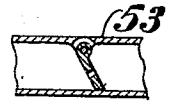


Fig. 5

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UNITED STATES PATENT OFFICE

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APPARATUS FOR VULCANIZING RUBBER TIRES, TUBES, AND THE LIKE

Application filed August 12, 1931. Serial No. 556,508.

This invention relates to a method and apparatus for vulcanizing rubber tires, tubes and the like, and more particularly to the mechanism and method of operating the same for automatically controlling the cycle of certain operations in the vulcanization of tubes.

The present invention is an improvement over the inventions disclosed in our copending applications Ser. #414,302 filed December 16, 1929 and Ser. #418,233 filed January 3, 1930, and has for its main feature the simplification of the mechanism for automatically effecting the various operations in the cycle of a press or vulcanizer, and for performing several of these operations simultaneously, so that the duration of the cycle may be reduced.

Another feature of the invention relates to an arrangement whereby the breech lock or other locking device of a press or vulcanizer may be actuated simultaneously with the inflation of the diaphragm, which functions to bring the mold elements of the press into substantially exact registry, although there is preferably a slight lag in the inflation of the diaphragm with respect to the operation of latching the breech lock.

An additional feature of the invention relates to the use of a single fluid-operated motor valve for controlling the opening of the press and unlocking the breech lock, while a single fluid-operated motor valve controls the latching of the breech lock and the inflation of the diaphragm.

These and other novel features of the invention will appear from the detailed description and the claims when taken with the drawings in which Fig. 1 is a front elevation of an individual unit vulcanizer or press; Fig. 2 is a side elevation of this press represented in closed position in full lines and in open position in broken lines, said press having cooperating therewith a system of control according to the present invention; Fig. 3 is a diagrammatic representation of the control equipment, indicated in Fig. 2 for automatically controlling the sequence and duration of the various steps or operations necessary in actuating the press to vulcanize a tire or tube; Fig. 4 is an elevational view partially in section of one type of electro-pneumatic switch suitable for use as a part of the control equipment as indicated in the diagram of Fig. 3, and Fig. 5 is a view partially in section of a suitable check valve.

Referring especially to Figs. 1 and 2, 1 designates a base, and 1*a* a diaphragm casing of an individual tube vulcanizer or press of well-known form, comprising a loosely mounted or floating lower mold section 2 and an upper mold section 3 pivoted at 4 for movement between its open position represented in broken lines (Fig. 2) to its closed position in engagement with the lower mold section, as represented in full lines. As is well known, the upper mold section 3 is provided with arm 5 to the free end of which is pivotally connected at 6, piston rod 7 and piston 23. This piston is adapted for movement within the cylinder 8 under control of fluid pressure and gravity. Since the tube, while being vulcanized, is subjected to internal pressure, the sections 2 and 3 of the mold are locked closed during the vulcanization period by a breech lock 9 centrally mounted on the base for partial rotation. This breech lock has latches 10 arranged for rotary engagement with the lugs 11 on the top mold section, whereby the two mold sections are locked in closed position. At the lower end of the breech lock 9, there is fastened an arm 12 which is pivotally connected to the piston rod 13 and piston 40, mounted for movement in the breech lock cylinder 84.

The lower or floating section of the mold rests on an expansible annular diaphragm 14 supported within the diaphragm casing 1*a*, which diaphragm when expanded, serves to force the lower floating section 2 of the mold into such close contact with the upper mold section 3 that substantially no rubber is extruded at the joint between the sections.

With this general description of the more important elements of the press, it is believed that the invention will be best understood by setting forth the several steps or operations involved in operating the press to vulcanize a tube as diagrammatically indicated in Fig. 3.

In the operation of the vulcanizer it is only necessary for the attendant to insert a tube such as indicated at 15 into the open press,

and then attach the valve stem (not shown) of the unvulcanized tube to conduit 63 for inflation, as will be further pointed out. Then the operator depresses the handle 16 which is pivoted at 17 and arranged to open a vent or escape valve 18 for the conduit 19. This conduit normally supplies a controlling fluid pressure such as compressed air to the top of the motor diaphragm valve 20 to hold it in its open position, so that operating fluid pressure from the conduit 22 enters the interior of the cylinder 8 to force the piston 23 toward the right, thereby holding the press open and also fluid pressure enters into the left hand end of breech lock cylinder to hold the breech lock in its unlatched position. When the attendant by pressing the handle 16, opens the vent or release valve 18, the controlling fluid pressure at the top of the valve 20 is relieved which, in turn, cuts off the fluid pressure supply of conduit 22 from the left hand side of piston 23. The valve 20 at the same time, at its exhaust port also relieves fluid pressure from the piston 23, permitting the top section 3 of the mold to move under the action of gravity into its closed position and likewise relieves the pressure from the left hand end of the breech lock cylinder 84, so that when fluid pressure is applied at the proper time to the right hand end of this cylinder the breech lock may be moved to its locking position.

At the time when fluid pressure is released from the conduit 19, an electro-pneumatic switch 24 is actuated to start the operation of the mechanism of an electric clock diagrammatically indicated at 25. The structure of this clock and associated mechanism within the casing 38, is only diagrammatically represented in Fig. 3, but is preferably similar in construction and operation to that disclosed in the pending application of E. B. Foote, Serial No. 464,099, filed June 26, 1930.

The electro-pneumatic switch, as shown in Fig. 4, includes a cylinder 65 having an inlet connected to the fluid pressure source through conduit 26. Within the cylinder there is fixedly mounted at one end a compressible capsular structure 27, at the upper end of which there is fastened a U-shaped conducting element 28 adapted in its uppermost position to make electrical connection between the clips 29 and 30. These clips are respectively connected to the electrical conductors 31 and 32, which are included in the circuit of the electric clock 25. The arrangement of this electro-pneumatic switch is such that as long as fluid pressure is applied through conduit 26 to the capsular structure 27, this structure holds the conducting element 28 out of engagement with the mentioned clips, so that the circuit of the electric clock is incomplete. This clock, when started by the completion of its circuit at the electro-pneumatic switch, is arranged to cause a single rotation of cam 33 and then to come to a stop. On the periphery of this cam, there engages the cam follower 34 in the form of a bell crank lever which, in turn, actuates the tappet bar 35 having horizontal arms 36 and 37 to engage the tappets of pilot air valves 45, 41 and 49 to be referred to. As soon as the electric clock starts to operate, the cam 33 actuates the cam follower 34, which operates tappet bar 35 thereby causing its arm 36 to move away from the tappet of reverse acting pilot valve 49. This pilot valve thus operates to cut off controlling air pressure from conduits 50, 19 and 26, even after the attendant closed vent 18 by the release of starting handle 16, until the clock has caused a single rotation of the cam 33.

As the electric clock continues to rotate the cam 33, it further actuates the cam follower 34 which now, in turn, operates tappet bar 35. Arm 37 of this bar operates the air pilot valve 41 which, through conduit 42, applies the operating fluid pressure to the top of the motor valve 43. This motor valve is thus actuated to close its exhaust and to connect the fluid pressure supply from conduit 21 to conduit 44 having branches 44*a* and 44*b*, the former branch leading to the annular diaphragm 14 and the latter branch leading to the right hand side of the piston 40 in the breech lock actuating cylinder 84. It will be noted that the branch conduit 44*a* has a portion 75 in which the passage-way in the conduit is restricted to an orifice of one-eighth of an inch. This restriction is provided to delay the inflation of the diaphragm 14 until the piston 40 has been moved to its extreme left hand position, for the purpose of locking the breech lock. As the electric clock 25 continues to rotate the cam 33, the air pilot valve 45 is next actuated to apply fluid pressure to the top of the valve 46 which, on operation, closes its exhaust and connects the fluid pressure from the conduit 21 to the conduit 63 for the purpose of inflating the tube 15.

The operations just referred to are effected during the very short time that the cam follower 34 is moving from its normal position, as shown, up the inclined portion 48 of the cam 33, to the regular portion of the periphery of this cam. It will be understood that while the cam follower 34 is riding on the regular portion of the cam 33, the vulcanization of the tube is being completed. Then, when the cam follower drops into notch 49, the pilot air valve 45 releases pressure from the motor valve 46, so that it disconnects fluid pressure from the conduit 63 and permits the tube 15 to be deflated through this conduit. Subsequently, when the cam follower drops into notch 50, the pilot air valve 41 relieves the controlling pressure in conduit 42, so that the motor valve 43 releases, to disconnect operating fluid pressure from the conduit 44

and to connect this conduit to the exhaust. This permits the diaphragm 14 to be deflated and also releases pressure from the right hand end of breech lock cylinder 84, so that the piston 40 may be moved to the right to unlock the breech lock. As the cam rotates further, the cam follower 34 drops into the notch shown as its normal position. When the cam follower 34 reaches this normal position, it permits the arm 36 to engage the tappet of the reverse-acting valve 49 whereby this valve applies fluid pressure through the conduit 50 to the conduit branches 19 and 26. Conduit 26 now applies fluid pressure to the electro-pneumatic switch 24, to open the circuit of the electric clock and thereby determine the end of its cycle of rotation. The pressure applied to the conduit 19 actuates the valve 20 to close its exhaust and to connect fluid pressure through the conduit 22 to the left hand side of the piston 40 which unlocks the breech lock, and to apply pressure to the left hand side of the piston 23, (Fig. 3), to elevate the top mold section 2 of the press. It should be noted that the conduit 52 has a check valve 53 included therein, which is in the nature of a flapper valve so arranged that fluid pressure is slowly introduced into the left hand end of the cylinder 8, to cause the mold to open slowly, and to insure that pressure will be built up rapidly in the left hand side of cylinder 84 so that the breech lock will be unlatched before the mold section 3 starts to open. However, when fluid pressure is being released from the left hand side of this cylinder to close the press, this flapper valve offers no impedance. In other words, the press closes quickly and opens slowly.

From the foregoing description, it will be observed that only three main motor valves are necessary to control the several steps in the cycle of operation of the press. This is due to the fact that certain of these operations are simultaneously effected, so that a single valve can be used to control two different operations.

In addition to the saving in cost by the reduction of the number of the main motor valves to a total of three, the main advantage of the present invention lies in the fact that it permits the vulcanizing apparatus to close more quickly than in prior arrangements where a greater number of motor valves was used. This quick closing of the apparatus reduces delay from the time one side of the tube comes in contact with the lower mold section until it comes in contact with the upper mold section and is fully inflated. In this way all parts of the tube are more uniformly cured.

We claim:

1. The combination with a tube vulcanizer having a mold divided into sections, at least one of which sections is movable, means for controlling the closing of said mold including a cylinder and a piston, said piston being operatively connected to at least one of said sections, a breech lock for locking said mold closed, means for actuating said breech lock including a cylinder and a piston, and a fluid pressure operated diaphragm for bringing said mold sections into registration, of a pressure regulating system including a conduit connected to one end of each of said cylinders, a single motor valve for admitting fluid pressure into said cylinders through said conduit to hold said mold in open position and to hold said breech lock unlatched, a second conduit connected with said diaphragm and with the other end of said breech lock cylinder, a single motor valve for admitting fluid pressure into the said last-mentioned conduit, a third conduit connectible to the tube to be vulcanized, a third motor valve admitting fluid pressure to said third conduit for inflating said tube, a source of fluid pressure connectible to all of said conduits through said valves, and means for controlling the sequence and duration of the operation of said valves.

2. The combination with a tube vulcanizer having a mold divided into sections, at least one of which sections is movable, means for closing said mold including a cylinder and a piston, said piston being operatively connected to at least one of said sections, a breech lock for locking said mold closed, means for actuating said breech lock including a cylinder and a piston, and a fluid pressure operated diaphragm for bringing said mold sections into registration, of a pressure regulating system including a conduit connected to one end of each of said cylinders, a single motor valve for admitting fluid pressure into said cylinders through said conduit to hold said mold in open position and to hold said breech lock unlatched, a second conduit connected with said diaphragm and with the other end of said breech lock cylinder, a single motor valve for admitting fluid pressure into said last-mentioned conduit, a third conduit connectible to the tube to be vulcanized, a third motor valve admitting fluid pressure to said third conduit for inflating said tube, a source of fluid pressure connectible to all of said conduits through said valves, and means actuated in accordance with time for controlling the sequence and duration of the operation of said valves.

3. The combination with a tube vulcanizer having a mold divided into sections, at least one of which sections is movable, means for closing said mold including a cylinder and a piston, said piston being operatively connected to at least one of said sections, a breech lock for locking said mold closed, means for actuating said breech lock including a cylinder and a piston, and a fluid pressure operated diaphragm for bringing said mold sections into regisrtation, of a pressure regulat-

ing system including a conduit connected to one end of each of said cylinders, a single fluid pressure operated valve for admitting fluid pressure into said cylinders through said conduit to hold said mold in open position and to hold said breech lock unlatched, a second conduit connected to said diaphragm and with the other end of said breech lock cylinder, a single fluid pressure operated valve for admitting fluid pressure into the said last-mentioned conduit, a third conduit connectible to the tube to be vulcanized, a third fluid pressure operated valve admitting fluid pressure to said third conduit for inflating said tube, a source of fluid pressure connectible to all of said conduits through said valves, a second source of fluid pressure and a series of pilot valves actuated in accordance with a predetermined time cycle to control the application of fluid pressure from said second source to said first-mentioned valves.

4. The combination with a tube vulcanizer having a mold divided into sections, at least one of which sections is movable, means for closing said mold including a cylinder and a piston, said piston being operatively connected to at least one of said sections, a breech lock for locking said mold closed, means for actuating said breech lock including a cylinder and piston, and a fluid-pressure operated diaphragm for bringing said mold sections into registration, of a pressure regulating system including a conduit connected to one end of each of said cylinders, a single valve for admitting fluid pressure into said cylinders through said conduit to hold said mold in open position and to hold said breech lock unlatched, a second conduit connected with said diaphragm and with the other end of said breech lock cylinder, a single valve for admitting fluid pressure into said last-mentioned conduit, means in said last-mentioned conduit for delaying the application of fluid pressure to said diaphragm with respect to said breech lock cylinder, a third conduit connectible to the tube to be vulcanized, a third valve admitting fluid pressure to said third conduit for inflating said tube, a source of fluid pressure connectible to all of said conduits through said valves, and means for controlling the sequence and duration of the operation of said valves.

5. The combination with a tube vulcanizer having a mold divided into sections, at least one of which sections is movable, means controlling the closing of said mold including a cylinder and a piston, a breech lock for locking said mold closed, means for actuating said breech lock including a cylinder and a piston, and a fluid pressure operated diaphragm for bringing said mold sections into registration, of a time pressure regulating system, including a conduit connected to one end of each of said cylinders, a single valve for admitting fluid pressure into said cylinders through said conduit to hold said mold in open position and to hold said breech lock unlatched, a second conduit connected with said diaphragm and with other end of said breech lock cylinder, a single valve for admitting fluid pressure into said last-mentioned conduit, a third conduit connectible to the tube to be vulcanized, a third valve admitting fluid pressure to said third conduit for inflating said tube, a source of fluid pressure connectible to all of said conduits through said valves, and manually controlled means for initiating the release of said first-mentioned valve, and means initially operated in response to the operation of said manually operated means for controlling the sequence and duration of the operation of said remaining valves.

6. In a vulcanizing device, a press having mold sections, means for closing said mold sections, a lock for holding said sections closed, registering means for bringing said mold sections into registry, and means for simultaneously initiating the operation of the locking means and the registering means.

7. In a vulcanizing device, a press having mold sections, means for closing said mold sections, a lock for holding said sections closed, registering means for bringing said mold sections into registry, and means for simultaneously initiating the operation of the locking means and the registering means while retarding the complete operation of said registering means.

8. In a vulcanizing device, a press having mold sections, means for closing said mold sections, a lock for holding said sections closed, an inflatable diaphragm to bring said mold sections into registry, and means for simultaneously initiating the operation of the locking means and the inflation of said diaphragm.

9. In a vulcanizing device, a press having mold sections, means for closing said mold sections, a lock for holding said sections closed, an inflatable diaphragm to bring said mold sections into registry, and means for simultaneously initiating the operation of the locking means and the inflation of said diaphragm while retarding the inflation of said diaphragm.

10. In a vulcanizing device, a press having mold sections, means for opening and closing said mold sections, a lock for holding said sections closed, means for bringing said mold sections into registry, means for simultaneously initiating the locking of said lock and the operation of said registering means, and means for simultaneously initiating the unlocking of said lock and the operation of the opening means for the molded sections.

11. In a vulcanizing device, a press having mold sections, means for opening and closing said mold sections, a lock for holding said sections closed, an inflatable diaphragm for bringing said mold sections into registry,

means for simultaneously initiating the operation of the locking means and the inflation of said diaphragm while retarding the inflation of said diaphragm, and mechanism for simultaneously initiating the unlocking of said lock and the operation of the means for opening the mold sections while delaying the operation of said opening means.

In testimony whereof we affix our signatures.

JOHN R. STRICKLEN.
SAMUEL A. FRAINE.