July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 1

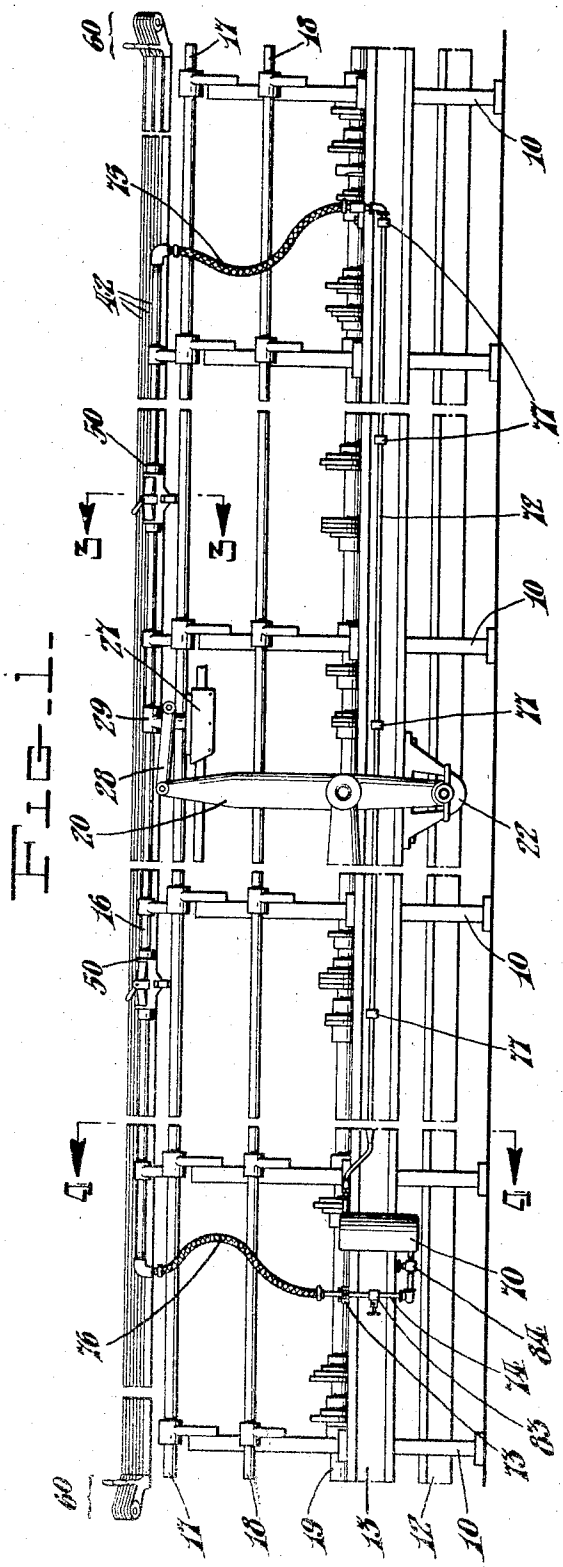


FIG. 1

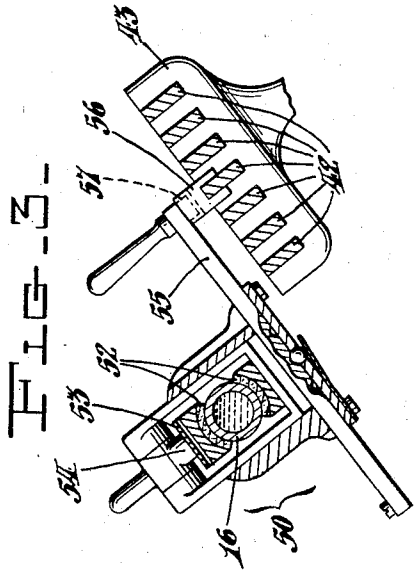


FIG. 3

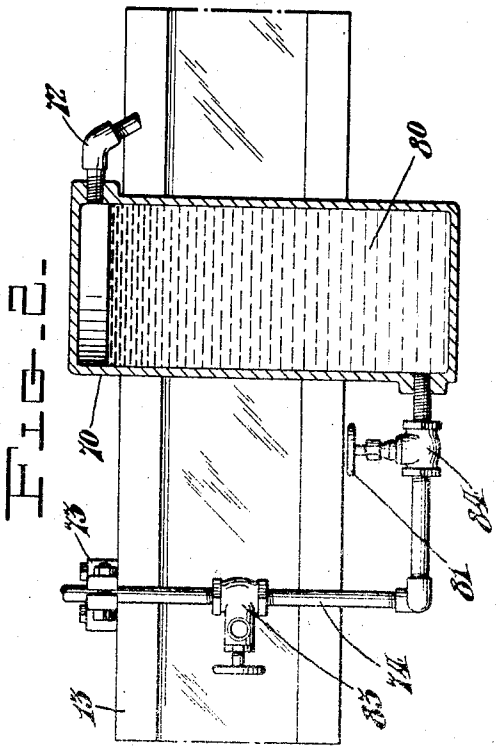


FIG. 2

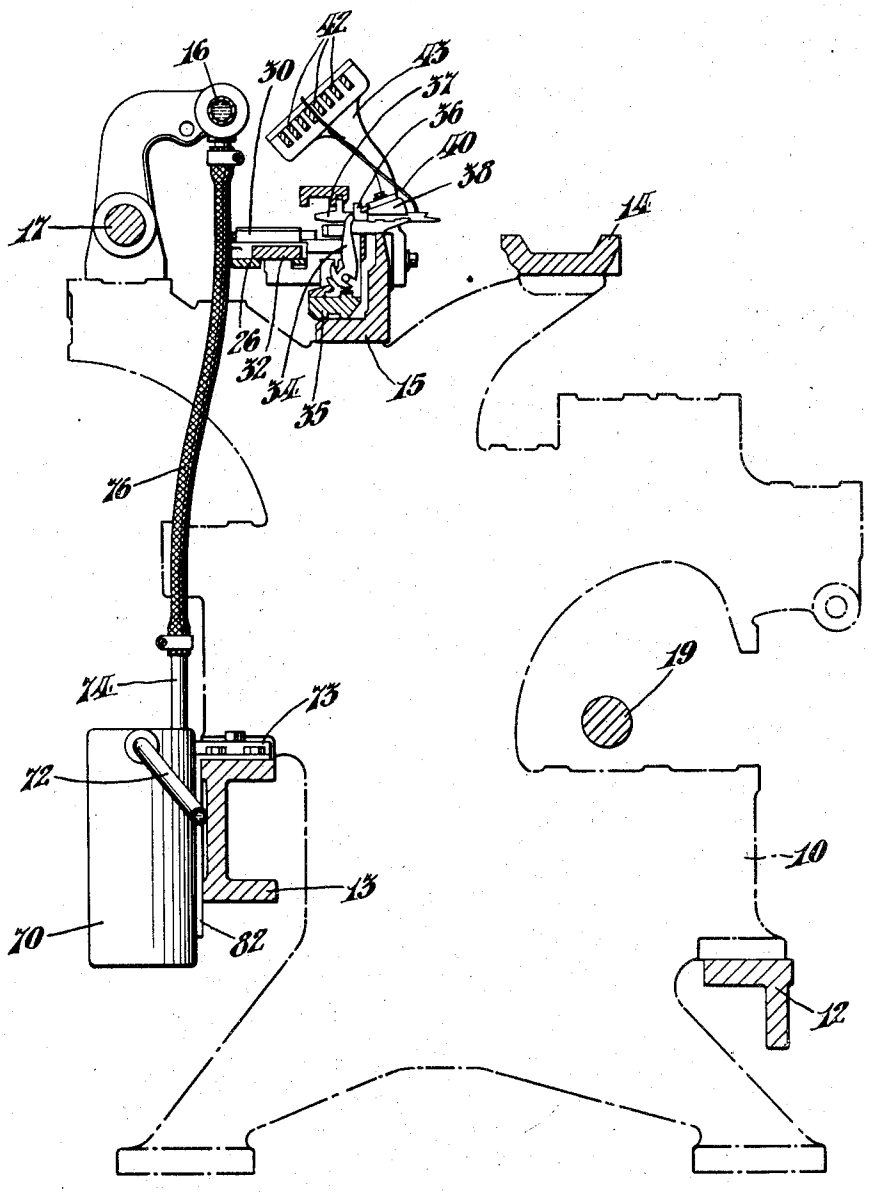
INVENTOR:
Charles S. Aschenbrenner
BY
Siegfried E. Reichmann
ATTORNEY.

July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 2

Fig. 4.



INVENTOR:
Charles S. Aschenbrenner,
BY
Alfred E. Ackinger,
ATTORNEY.

July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 3

FIG. 5.

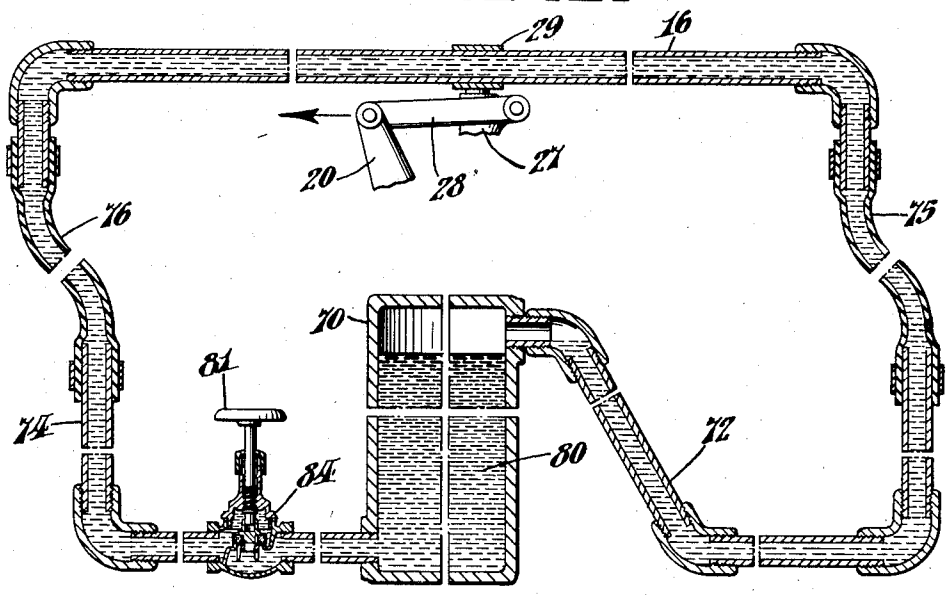
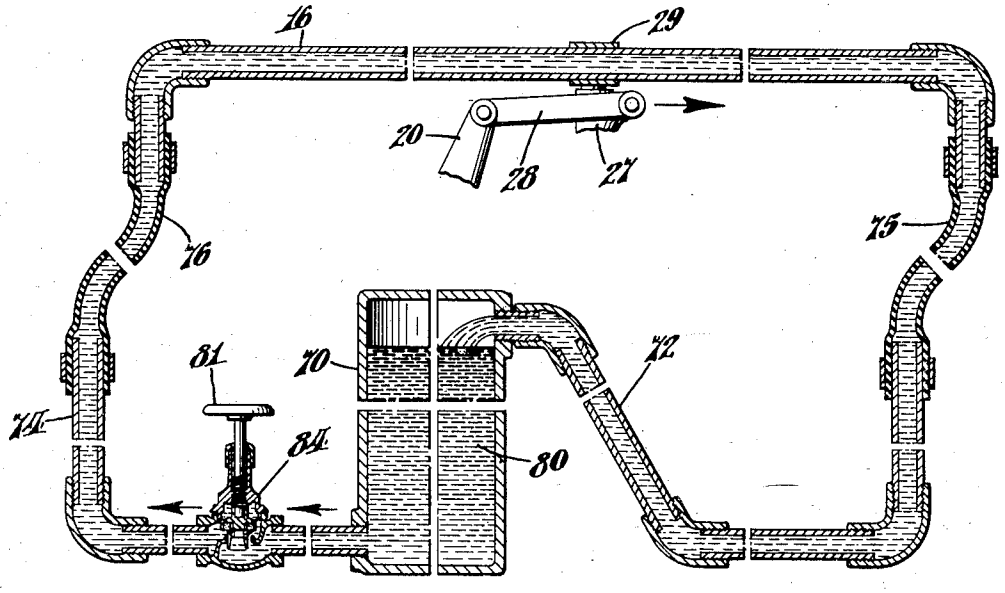


FIG. 6.



INVENTOR:
Charles S. Aschenbrenner,
BY
Fred E. Eschinger
ATTORNEY.

July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 4

Fig. 8.

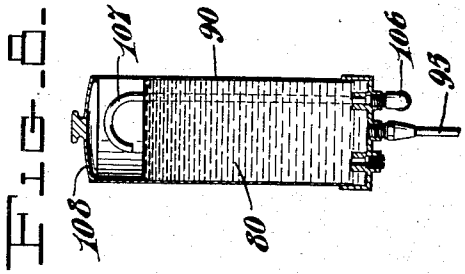


Fig. 7.

INVENTOR:
Charles S. Aschenbrenner,
BY
Alfred E. Aschinger
ATTORNEY.

July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 5

FIG. 9.

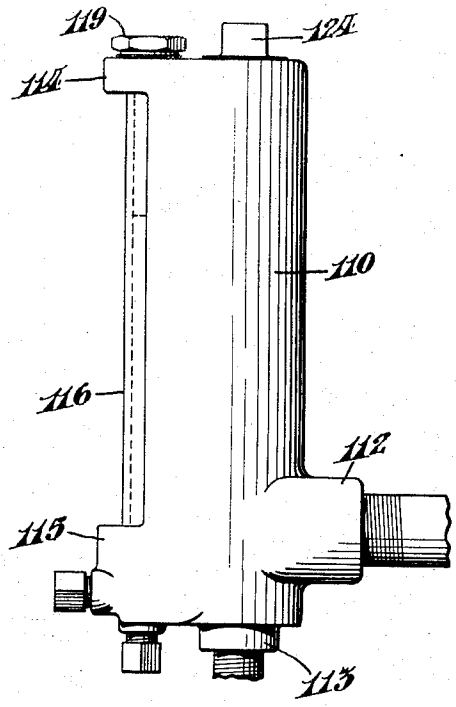


FIG. 10.

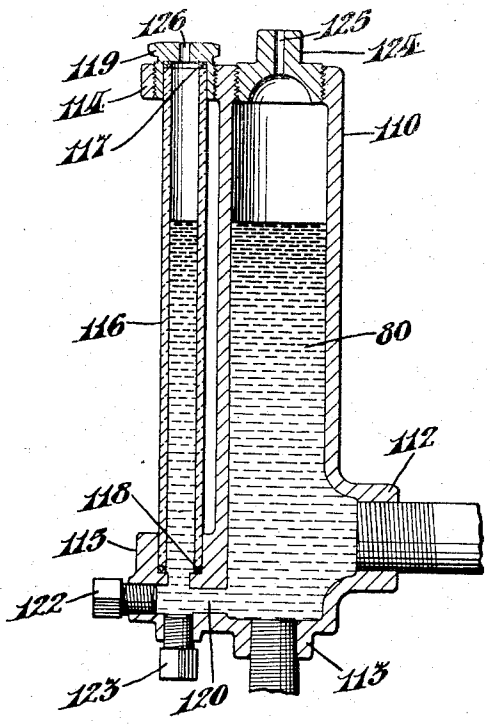


FIG. 11.

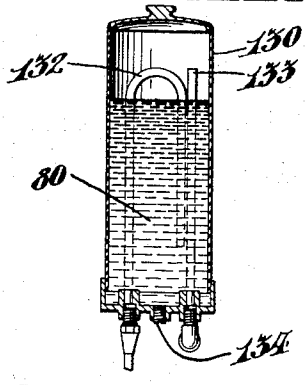


FIG. 12.

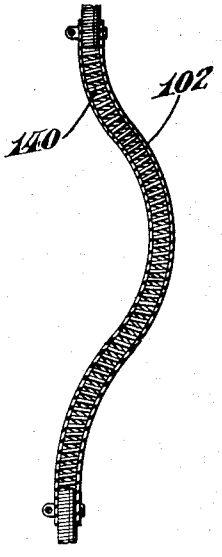
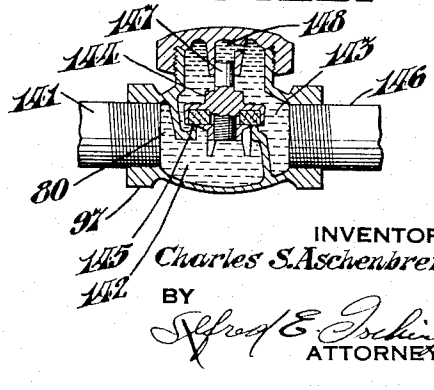


FIG. 13.



INVENTOR:
Charles S. Aschenbrenner,
BY
Alfred E. Jochinger
ATTORNEY.

July 25, 1944. C. S. ASCHENBRENNER 2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Filed Jan. 2, 1941 6 Sheets-Sheet 6

FIG. 14.

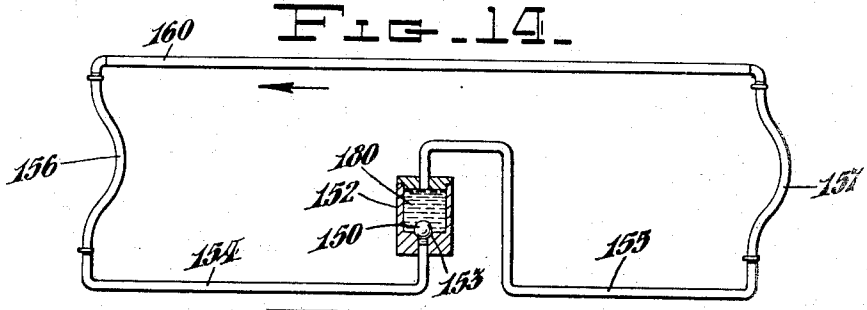


FIG. 15.

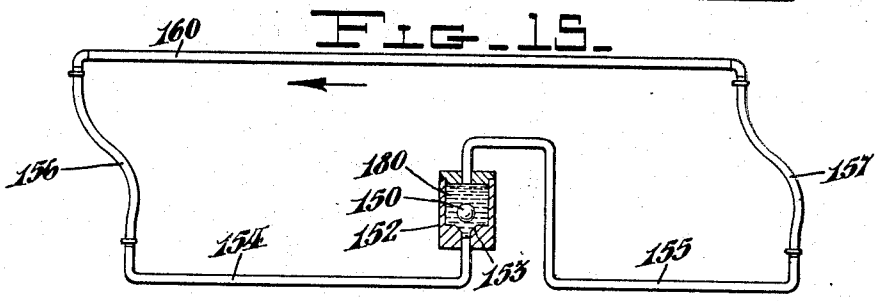


FIG. 16.

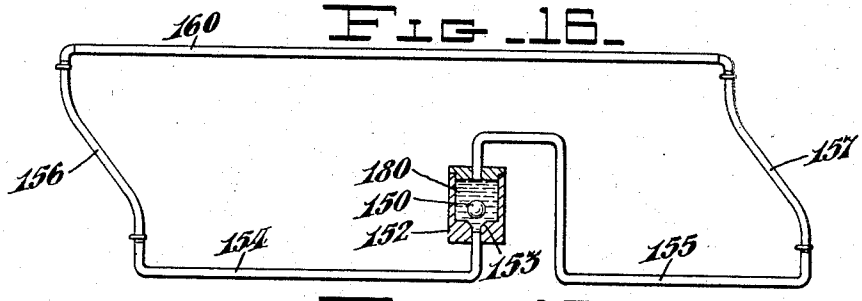


FIG. 17.

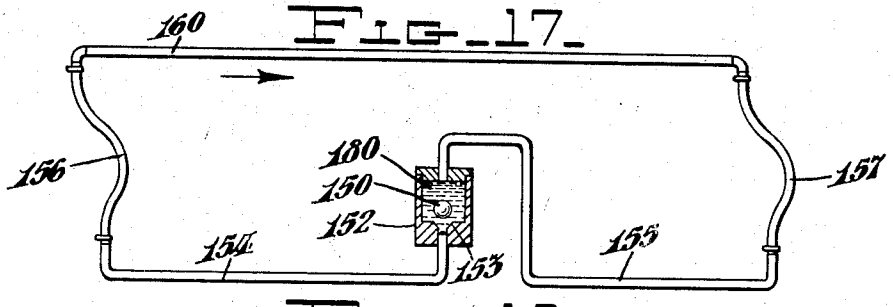
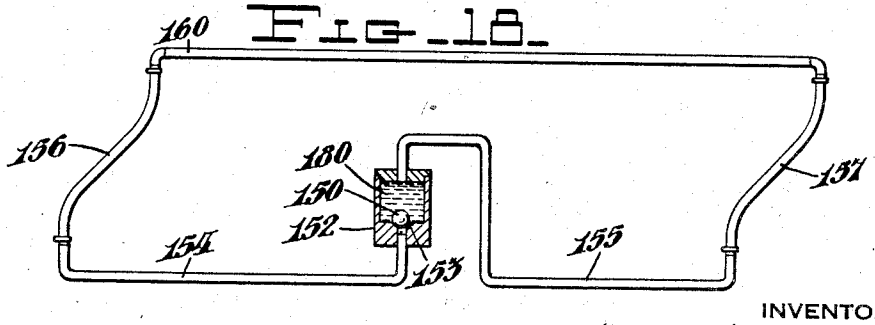


FIG. 18.



INVENTOR:
Charles S. Aschenbrenner,
BY
Alfred E. Ackinger
ATTORNEY.

Patented July 25, 1944 2,354,188

UNITED STATES PATENT OFFICE

2,354,188

FLUID CIRCULATING APPARATUS FOR KNITTING MACHINES AND THE LIKE

Charles S. Aschenbrenner, Temple, Pa., assignor to Textile Machine Works, Wyomissing, Pa., a corporation of Pennsylvania

Application January 2, 1941, Serial No. 372,729

19 Claims. (Cl. 66—126)

This invention relates to a novel method of and liquid-circulating means for modifying the temperature of reciprocating machine members, such, for example, as the reciprocating friction rod of a straight or full-fashioned knitting machine.

In a full-fashioned knitting machine used to manufacture hosiery, the varying width of the fabric blanks produced requires means for feeding the yarn correspondingly varying lengths. This variation in the length of the carrier stroke is generally provided for by an arrangement including a carrier rod actuator or friction box in frictional engagement with a reciprocating member known as a friction rod. The frictional engagement between these two members is initially set to prevent slippage between the box and rod during the normal traverse of the carrier, and permits the rod to slide relative to the box after the travel of the associated carrier is stopped upon engagement with a stop member. However, when the carrier rod reaches the end of its stroke and the friction rod continues its movement, the repeated slippage of the rod through the friction box, at regular intervals during uninterrupted operation of the machine, and more particularly when knitting with short stroke carriers as when splicing, or during fashioning when the travel of the carriers is progressively shortened while the travel of the friction rod remains unchanged, heats and in turn expands these members to such an extent that the binding action between the friction box and rod frequently becomes so intense as to adversely affect the operating efficiency thereof.

To dissipate the heat generated by friction and to keep the friction rod and box of a full-fashioned knitting machine at a uniform temperature and thereby keep it in proper operating condition at all times, it has heretofore been suggested to apply a cooling or a temperature control medium to the interior of the friction rod, as disclosed in the C. F. Meyer Patents Nos. 1,971,316 and 2,018,460 dated August 21, 1934, and October 22, 1935, respectively.

While, for the reasons hereinabove stated, it is generally desired to cool the friction box rod of a full-fashioned knitting machine, it is evident that, in cold weather, the lubricant on the rod and the friction leathers commonly used for transmitting the motion of the rod to the friction box may become so stiff as to cause an undue wear on the leathers for a time after starting up if the friction boxes were immediately engaged with the friction box rod. Under such conditions it will become apparent from the following description that the method and means according to my invention may be used to warm the friction rod of a knitting machine, or other reciprocating member, instead of cooling it. When it is desired to warm a reciprocating member instead of to cool it, it is necessary only to substitute a relatively warm liquid for a relatively cool one in the temperature modifying means of the invention.

The reciprocating movement of knitting machine friction rods has, however, presented an obstacle to the smooth operation of such prior art cooling devices heretofore used to circulate fluid therethrough, such obstacle more particularly arising by reason of the high peak loads placed on the device at certain points in its operative cycle. For example, when the hollow reciprocating rod travels in the same direction as the liquid being pumped therethrough, the load on the liquid circulating motor is negligible, but when the rod reverses its travel so as to move in a direction opposite to the flow of the liquid, the rod instead of helping to circulate the fluid therethrough opposes such circulation thereby so increasing the load placed on the circulating motor that the desired free and easy flow of liquid through the rod is impeded by momentary stalling of the pump. Continued repetition of such action results in undue wear of the machine parts, and generally reduces the efficiency of the entire fluid circulating system.

It is an object of this invention to provide novel means for circulating fluid through a hollow reciprocating machine member which overcomes the referred to and other objectionable features of prior art devices..

Another object of my invention is to provide a novel method and means for circulating fluid through a hollow reciprocating rod of the referred to type.

Another object is to provide a new method of circulating fluid through a closed circuit which involves the utilization of a hollow reciprocating machine member in said circuit as the means for inducing the flow of fluid therethrough during the movement of said member.

Another object is to provide fluid flow means or means whereby a fluid may be moved along with a reciprocating member in a closed circuit to induce flow of fluid through said circuit without the use of a motor or other special fluid flow means.

A further object is to provide automatic means for circulating fluid through a reciprocating rod of a full-fashioned knitting machine in which the motion of said rod is utilized to induce flow of the fluid through said rod.

A still further object is to provide novel means for maintaining the flow capacity of a flexing hose uniform during its cooperative movement with a reciprocating machine member.

With these and other objects in view which will become apparent from the following detailed description of the illustrative embodiment of my

improvements shown in the accompanying drawings, my invention resides in a fluid circulating system embodying the novel elements, features of construction and arrangement of parts in cooperative relationship, and the method of circulating fluid as effected by this device, as hereinafter more particularly pointed out in the claims.

In the drawings:

Figure 1 is a rear elevational view showing portions of a multi-section full-fashioned knitting machine having applied thereto one practical embodiment of my invention;

Fig. 2 is a detail view, partially in section, of part of the mechanism shown in Fig. 1;

Fig. 3 is an enlarged sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view taken substantially along the line 4—4 of Fig. 1;

Figs. 5 and 6 are schematic illustrations, shown in section, depicting progressive steps in the operation of the fluid circulating system of my invention;

Fig. 7 is an elevational view of a modification of the invention and of a portion of a knitting machine with which it is adapted to cooperate;

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 7;

Fig. 9 is an elevational view of a modified form of reservoir having a fluid level gauge embodied therein;

Fig. 10 is a sectional view of the reservoir shown in Fig. 9;

Fig. 11 is a view, similar to Fig. 8, of a modified form of reservoir;

Fig. 12 is a sectional view of one of the flexible conduits shown in Fig. 7;

Fig. 13 is a sectional view of one of the check valves of Fig. 7; and

Figs. 14 to 18, inclusive, are a series of diagrammatic views of a fluid circulating system in accordance with the present invention, showing the sequential positions of different parts at different steps in its operative cycle.

In the drawings and description, only the means and method necessary to complete understanding of the invention have been specifically set forth; further information as to the construction and operation of other related, usual and well known knitting machine elements, mechanisms, etc., may be found in one or more of the following publications:

1. Pamphlet entitled—Full-Fashioned Knitting Machines—published and copyrighted by the Textile Machine Works, Reading, Pennsylvania, in 1920.
2. Three catalogs entitled—The "Reading" Full-Fashioned Knitting Machine Parts Catalog—published and copyrighted by the Textile Machine Works, in 1929, 1935 and 1940, respectively.
3. Booklet entitled—The "Reading" High-Production Full-Fashioned Knitting Machine—which forms a supplement to the above noted 1940 Parts Catalog of the Textile Machine Works, and which Booklet is a publication of the Textile Machine Works, and was copyrighted by the latter in 1940.
4. Pamphlet entitled—Knitting Machine Lectures—published by the Wyomissing Polytechnic Institute, Wyomissing, Pennsylvania, in 1935.

The machine member disclosed herein as the one to which the invention has been applied is the friction box rod of a straight knitting machine, a member which it is generally desired to cool in use. However, the application of my invention is not limited to cooling or to the knitting arts as it may be employed in connection with any reciprocating machine member which it is desired to warm or to cool.

A full-fashioned knitting machine of the multi-section type to which the present invention is particularly adaptable, generally comprises a series of spaced upright frame members 10, Figs. 1 and 4, which support a plurality of parallel horizontal frame members including front beam 12, back beam 13, front bed 14 and center bed 15. These upright and horizontal frame members effect a framework structure upon which the operative mechanisms of the machine, including a friction rod 16, a back narrowing shaft 17, a back catch bar shaft 18, and camshaft 19, are operatively supported.

A rocker arm 20 which is pivotally mounted in a bearing 22 supported by the back beam 13, forms a part of the usual coulier mechanism (not shown) which receives its motion from the camshaft 19 in well known manner. The oscillating movement of the rocker arm 20 is utilized to reciprocate a friction rod 16 and a connecting bar 26, by means of a bracket 27 to which the upper or free end of the rocker arm 20 is connected through a link 28. The bracket 27 is rigidly fastened to the connecting bar 26 and is connected to the friction rod 16 through a crosshead 29. Fixed to the connecting bar 26 at equally spaced intervals are a series of slur cam boxes 30, one box being provided for each knitting section of the machine. These boxes are guided for reciprocation on a guide bar 32, supported by the center bed 15, and actuate jacks 34 of jack beds 35 to forwardly impel sinkers 36 which are slidably mounted and operate in sinker head 38 in the usual manner. Yarn carriers 40 which are carried by carrier rods 42, in turn mounted for free reciprocation in carrier brackets 43 secured to the center bed 15, are used to feed yarn to the loop forming mechanism of the machine including sinkers 36 and dividers 37. A friction box 50, Fig. 3, which is frictionally engageable with the friction rod 16 by means of friction shoes 52, a bowed leaf spring 53 and a cam arrangement 54, carries a slide member 55 having a forward portion 57 shown as being adapted to engage a dog 56 on one of the carrier rods 42 to thereby reciprocate the yarn carrier or thread guide 40 through an operative stroke, the length of which stroke is determined by the positioning of the end stops 60 between which the body yarn carrier rods reciprocate.

Although the reciprocating stroke of the coulier mechanism including the friction rod 16 is constant, the strokes of the carriers vary depending upon the extent of fashioning done to the fabric. In view of this, provision is made in the form of narrowing heads (not shown) to change the position of the end stops 60, and thereby limit the travel of the rods 42, and consequently of the yarn carriers 40 and the friction box 50, to the width of fabric desired. Furthermore, to provide a sufficient time interval between operative strokes of the yarn carriers 40 when feeding yarn for full width fabric so that the loop forming elements including the sinkers 36, dividers 37, and the needles and knockover-bits (not shown) may operate to knit the yarn into fabric, the extent of travel of the

bracket 27, and consequently of the friction rod 16 and the connecting bar 26, is necessarily greater than the longest operative stroke of the yarn carriers 40, as a result of this an appreciable amount of slippage takes place between the friction rod 16 and the friction box 50 at the end of each reciprocating stroke of the couliering mechanism; the shorter the stroke of the carrier rods 42 the greater the extent of such slippage at the end of each stroke thereof. Short stroke operation of certain of the carriers, as for instance those used when knitting the high heel reinformed areas and/or the heel tabs, further increases the extent of slippage between the friction box and the friction rod.

It is this slippage or relative frictional movement between the friction rod 16 and the friction boxes 50 that results in the development of friction and the resultant heating of these cooperating members, the temperature of which must necessarily be kept within definite limits for proper operation of these frictionally engaged members.

To maintain the friction rod 16 at a substantially uniform temperature at all times, a temperature control medium such as a cooling fluid is desirably circulated therethrough.

This is effected in accordance with the present invention, by means of a self circulating closed system (Figs. 1, 2, 4, 5 and 6), which generally comprises a stationary reservoir 70 connected to the hollow friction rod 16 by stationary pipe connections 72 and 74, in turn supported on the back beam 13 by brackets 73 and 77, respectively, and intermediate flexible conduits or hose connections 75 and 76. In this system, fluid 80 from the reservoir 70, Fig. 2, is circulated through the rod 16 to dissipate some of the heat generated between the friction box and rod to keep the temperature of the rod from rising above a given point, and in this way maintain the apparatus in proper operating condition. The reservoir 70 is preferably secured to a bracket member 82 which is bolted to the back beam 13 in the manner shown in Fig. 4. A valve arrangement 83 is provided in the line 74 to facilitate replenishing the fluid supply in the system. A check valve 84, shown in section in Figs. 5 and 6, is provided to control the direction of flow of the fluid through the system; said valve including a manual control in the form of a handwheel 81.

With the rocker arm 20 and the friction rod 16 at the left end of their operative strokes (Fig. 5), as viewed from the rear of a full-fashioned knitting machine, see Fig. 1, upon movement of the mechanism toward the right end of its operative stroke shown in Fig. 6, the fluid 80 within the rod is carried therewith, as the flexible conduits or hose connections 75 and 76 bend to permit such action; there being no circulation of the fluid in the system during this part of the cycle. However, as the speed of the friction rod 16 is reduced when it approaches the end of its rightward travel, the fluid 80 therein, due to the inertia received during the full speed travel of the friction rod, does not lower its velocity in the same degree as the friction rod, and is consequently displaced relative thereto, whereupon circulation of the fluid through the system is effected as fluid flows through the rod 16, the conduit 75, the pipe 72, and into the reservoir 70, see Fig. 6. Meanwhile, the displacement of the fluid within the rod 16 causes fluid to be drawn from the reservoir through the check valve 84, the pipe 74, the valve 83, the conduit 76, and into the rod 16 to replenish the fluid displaced therefrom.

During the leftward or return stroke of the friction rod, i. e. from the position of Fig. 6, to the position of Fig. 5, the circulation of fluid through the system continues in the direction indicated in Fig. 6, until the retarding influence of the oppositely moving rod and fluid arrests the displacement of the fluid relative to the rod; whereupon the fluid, instead of flowing through the rod, is again carried therewith, but in this instance in a leftward direction toward the position shown in Fig. 5. As the friction rod approaches the end of its leftward stroke and the velocity thereof is reduced, displacement of the fluid relative to the rod in the direction of travel of the latter is prevented by the action of the check valve 84 which automatically closes, as in Fig. 5, as soon as the pressure thereon is reversed by the fluid tending to force its way therethrough from left to right as viewed in Fig. 5. However, upon return of the friction rod 16 from the position of Fig. 5 to that of Fig. 6, the above action is repeated as the check valve opens and the circulation of fluid 80 is again resumed in the manner previously related; such repeated action accordingly producing a pulsating current or flow of fluid through the friction rod and associated linkage during the operation of the machine.

In the modification of the invention shown in Figs. 7 and 8, a reservoir 90 is supported by a bracket 92 which is adjustably mounted on an upright post 93 secured to a gallow member 94. In this arrangement fluid from the reservoir enters the friction rod 16 through a vertical tube 95, horizontal pipe 96, check valve 97 and flexible conduit 98; whereas the fluid displaced from the rod 16 passes through a flexible conduit 102, check valve 103, lower horizontal pipe 104, vertical tube 105, upper horizontal tube 106, and thence through the gooseneck tube 107 into the reservoir 90. The operation of this arrangement is similar to that previously explained in connection with the apparatus shown in Figs. 1 to 6, and is diagrammatically illustrated in Figs. 14–18. In this arrangement fluid may be added to the system by removing lid 108 from the reservoir and filling the reservoir to the level desired, thereby eliminating the need of the valve 83 used in the system shown in Figs. 1 to 6. A second check valve 103, as shown in Fig. 7, has been included in this arrangement for the purpose of supplementing the action of valve 97 and to increase the overall efficiency of the system.

The reservoir arrangement shown in Figs. 9 and 10 comprises a standpipe member 110 having bosses 112 and 113 for connecting it in the system. Lug portions 114 and 115 extending from one side of the standpipe 110 are provided for supporting a glass tube 116 which serves as a gauge to indicate the level of the fluid 80 within the member 110. The tube 116 is held in position by a cap member 119 threaded into the lug 114, whereas washers 117 and 118 are provided at opposite ends of the tube to seal the tube against leakage of fluid therefrom. A duct 120 is provided intermediate the tube 116 and the standpipe member 110 to permit fluid to enter and rise to the same level in both members, whereas openings plugged by screws 122 and 123 are included to facilitate the construction and cleaning of the arrangement. A plug 124 is threaded into the upper end of the standpipe member 110 to permit fluid to be added to the

system, whereas an opening 125 therein, and a similar opening 126 in the cap member 119, are provided to expose both columns of fluid to the action of the surrounding atmosphere.

The reservoir 130 shown in Fig. 11 differs from that shown in Figs. 7 and 8 in that a siphon 132 is provided to feed fluid from the reservoir into the system by a siphon action instead of by gravity feed, whereas a straight pipe 133 is used to return the fluid from the system to the reservoir instead of a bent tube as in the previously described reservoir 90. By means of this arrangement the fluid is siphoned into the system from the reservoir at a point below the surface of the liquid and above the bottom of the tank so that any scum on the surface of the fluid or any sediment which may have collected at the bottom of the tank will not be circulated through the system. A plug 134 is threaded into the bottom of this tank to facilitate the cleaning thereof.

In order to prevent buckling or collapsing of the flexible conduits or hose connections 98 and 102, Fig. 7, a coil spring 140 is preferably placed inside thereof as shown in Fig. 12. The spring is held against axial displacement by the pipe connections at opposite ends thereof in the manner illustrated, this arrangement permitting bending of the conduit while preventing it from collapsing or buckling.

The check valves 97 and 103 used in a device constructed in accordance with the present invention are preferably of the type shown in section in Fig. 13. This valve 97 comprises a dual chamber arrangement in which fluid admitted through the connection 141 enters a chamber 142, lifts the valve element 144 from its seat 145 and passes into the chamber 143 from which it discharges through the pipe connection 146 and circulates through the system. Upon flow of fluid through the system in the direction indicated by the arrows, the valve element 144 as it is lifted from its seat 145 is guided in such movement by an upper cylindrical extension 147 thereof which is slidable in a complementary shaped portion 148 of the valve casing. The valve 97 is shown in Fig. 13 in closed position, and consequently fluid cannot pass from chamber 143 to chamber 142, inasmuch as movement of fluid in that direction automatically forces the valve element 144 down upon the valve seat 145. The operation and function of the valve 97 are similar to that of the check valve portion of the valve 84 shown in Figs. 1, 2, 5 and 6. The various operative positions of a check valve during a complete reciprocating cycle of a full-fashioned knitting machine are diagrammatically shown in Figs. 14–18.

The manner in which a reciprocating machine member and a check valve cooperate to circulate a temperature control medium through the reciprocating member in accordance with the invention is diagrammatically shown in Figs. 14–18 in connection with a circulating system comprising a reciprocating hollow rod 160, stationary pipe members 154 and 155 respectively serving as inlet and exhaust lines to a check valve 152, and flexible intermediate connectors 156 and 157. More specifically, these views show sequential steps in an operating cycle of a reciprocating friction rod of a full-fashioned knitting machine and the corresponding positions of a check valve element 150 of a check valve 152 in the fluid circulating system during these sequential steps, and the way in which the reciprocating rod 160 and the check valve 152 cooperate to circulate fluid 180 through the said rod.

When the friction rod 160 in its travel from right to left, as viewed from the rear of the machine, reaches the position shown in Fig. 14, the rod 160 and the fluid 180 contained therein are travelling in the same direction and at the same rate of speed, the check valve remaining closed as the ball or check element 150 remains at rest on the valve seat 153, as shown, there being no circulation of the fluid through the system at this point in the cycle.

However, as the rod 160 approaches the end of its stroke and reaches the position indicated in Fig. 15, its velocity is decreased in the customary manner preparatory to reversing its direction of travel, whereas the fluid 180, by reason of its inertia received from the rod 160 while traveling at full speed, continues its full speed motion thereby lifting the ball 150 from its seat 153 (Fig. 15) as the fluid circulates through the system.

Circulation of the fluid through the system continues, as above set forth, when the friction rod 160 reaches the end of its leftward stroke indicated in Fig. 16, and also during part of its return stroke to the right as shown in Fig. 17; the action of the liquid during such circulation maintaining the ball element in floating position above the valve seat 153 in the manner indicated.

This return motion of the friction rod 160 from left to right while the fluid 180 therein is flowing in the opposite direction, gradually reduces the flow velocity of the fluid until all of the inertia which it received from the friction rod during its previous travel from right to left, has been spent. Consequently, by the time the friction rod 160 has reached the end of its rightward stroke, which position is indicated in Fig. 18, the circulation of the fluid in the system has stopped, and although that fluid which is contained within the rod itself has meanwhile reversed its direction of movement, it being carried rightward by the rod 160 after its circulation has been stopped by the action of the oppositely moving friction rod, nevertheless, as the rod 160 approaches the end of its rightward stroke and its velocity is decreased preparatory to again reversing its direction of travel, the inertia of the fluid therein received from the rod during its rightward travel therewith although tending to displace the fluid relative to the rod, is prevented from so doing by the check valve 152 which is automatically closed by the fluid when the latter tends to circulate in a clockwise direction. Thus, the self operating check valve 152 automatically closes the system against circulation of the fluid in a clockwise direction, while permitting circulation in a counter-clockwise direction as viewed in Figs. 14–18; thereby controlling the direction of circulation of the temperature control medium through the reciprocating friction rod.

In a fluid circulating system constructed in accordance with this invention, the reciprocating motion of the member through which the cooling fluid is circulated provides the motive power needed to effect the desired circulation, said member being the sole flow inducing or fluid motivating element needed in the fluid circulating circuit, whereas a check valve in the system acts to control the direction of such circulation. It will be understood that in this arrangement the influx of fluid to the reciprocating rod bal-

ances the efflux therefrom, and that a full flow of fluid through the rod is consequently maintained at all times, thereby preventing air from entering the system and eliminating the decrease in the efficiency of the system which would occur if air were admitted. In an arrangement constructed in accordance with the present invention, any rise in the temperature of the fluid occasioned during its flow through the friction rod is dissipated between the time it leaves the rod and the time it reenters it by reason of the fact that the length of pipe through which it passes between repeated flow through the friction rod, acts as a cooling or radiator arrangement, as a result the fluid is always fed to the friction rod at a substantially constant temperature. The degree of cooling of the fluid may readily be increased by increasing the length or arrangement of the pipes through which it flows.

Obviously, an arrangement constructed in accordance with the present invention, may utilize suction, siphon action, gravity feed, or any other well known principle, or combination thereof, to feed fluid from the reservoir to the circulating system.

Although various fluids may be utilized as a temperature control medium in apparatus of this type, it has been found that water treated with an anti-rust solution is satisfactory for all practical purposes. Of course, the improvements shown and specifically described by which I obtain the above results can be changed and modified in various ways without departing from the invention herein disclosed and hereinafter claimed.

However, it is obvious from the foregoing that my invention can be applied to warming a reciprocating machine member as well as to cooling it. Further, it is to be understood that the words "reciprocating" and "reciprocatively" where appearing in the following claims are to be taken in a broad sense as including oscillating action as well as rectilinear reciprocation.

I claim:

1. The method of circulating fluid through a temperature modifying closed circuit, said circuit including a hollow motion transmitting machine member which forms a part only of the circuit, which consists in reciprocating said machine member and during said reciprocation preventing the flow of fluid in one direction and causing flow of said fluid through said circuit in the opposite direction solely by the inertia of the fluid itself caused by the reciprocating action of said member.

2. The method of circulating fluid through a temperature modifying closed circuit, said circuit including a hollow motion transmitting machine member which forms a part only of the circuit and flow restricting means, which consists in reciprocating said machine member to impart momentum to said fluid and utilizing solely the momentum of said fluid in one direction to circulate fluid through said circuit and checking the flow of the fluid in the opposite direction by said means to cause a net circulation of said fluid.

3. A method of circulating fluid through a temperature modifying closed circuit in a full fashioned knitting machine, said circuit including a hollow reciprocating friction rod which forms a part only of the circuit, which consists in utilizing the movement of the friction rod to circulate said fluid always in one direction through said circuit.

4. The method of effecting a pulsating circulation of temperature modifying fluid through a hollow reciprocating machine member of a straight knitting machine which consists in utilizing solely the inertia of the fluid as exerted thereby in one direction to displace the fluid relative to the machine member during retardation of said member and its acceleration in the opposite direction and preventing movement of the fluid relative to the machine member in the opposite direction.

5. The method of effecting a pulsating circulation of fluid through a closed circuit cooling system of a full fashioned knitting machine having a hollow reciprocating friction rod which consists in imparting motion to the fluid in the friction rod upon movement of the latter in one direction, reversing the direction of travel of the rod as the inertia of the fluid therein to move in said one direction effects displacement thereof relative to said friction rod, and preventing the reverse flow of the fluid in said friction rod to control the direction of flow of the fluid in said system.

6. A temperature modifying liquid circulating system for straight knitting machines comprising a hollow reciprocating member, a hollow stationary member, flexible conduits connecting the ends of said reciprocating and stationary members in a closed circuit for the circulation of liquid therethrough as activated by said hollow reciprocating member, and check valve means for controlling the direction of flow of said liquid through said system, said circuit being free of association with any fluid motivating element other than said reciprocating member.

7. In a temperature modifying fluid circulating system for straight knitting machines and the like, the combination comprising a hollow reciprocating member, a hollow stationary member, hollow flexible connectors intermediate said reciprocating and stationary members for circulation of fluid through said reciprocating and stationary members in a closed circuit, and valve means in said system permitting flow of said fluid through said system in one direction only, said circuit being free of association with any fluid motivating element other than said reciprocating member.

8. In a temperature modifying fluid circulating system for straight knitting machines, the combination with a hollow reciprocating member, a hollow stationary member and hollow flexible connectors intermediate said reciprocating and stationary members, of check valve means in said system for controlling the direction of flow of said fluid through said system as produced by the motion of said reciprocating member, said system being free of association with any fluid motivating element other than said reciprocating member.

9. In a fluid circulating system for full fashioned knitting machines and the like, the combination comprising a hollow reciprocating friction rod, a stationary reservoir, hollow connector means intermediate said rod and reservoir effecting a closed circuit, and self operating valve means for maintaining unidirectional circulation of said fluid through said system as produced by the movement of said reciprocating member, said circuit being free of any fluid motivating element other than said reciprocating friction rod.

10. In a fluid circulating system for full fashioned knitting machines and the like, the combination comprising a hollow reciprocating friction rod, a stationary reservoir means, hollow

connector means intermediate said rod and reservoir effecting a closed circuit, and self operating valve means in said system for flow of fluid therethrough as produced by the movement of said reciprocatory member in one direction, and for preventing reversal in the flow of said fluid therethrough upon reverse movement of said friction rod, said circuit being free of any fluid motivating element other than said reciprocating friction rod.

11. In a closed circuit fluid circulating temperature modifying system for straight knitting machines and the like, the combination comprising hollow reciprocating and stationary members and connectors intermediate said members arranged for circulation of fluid through said system as produced by operation of said reciprocating member, and valve means associated with said stationary member for controlling the direction of flow of said fluid through said system, said system being free of association with any fluid motivating element other than said reciprocating member.

12. In a closed circuit fluid circulating temperature modifying system for straight knitting machines and the like, the combination comprising a hollow reciprocating member, a hollow stationary member, hose connections intermediate said hollow members, fluid means in said system, and valve means associated with said stationary member for controlling the direction of flow through said system as activated by said reciprocating member, said system being free of association with any fluid motivating element other than said reciprocating member.

13. In a full fashioned knitting machine having a hollow friction rod and means for reciprocating said friction rod, of a reservoir in and connections forming a temperature modifying circuit with said rod having fluid therein and arranged to keep said rod filled therewith, and valve means in said circuit for controlling the direction of flow of said fluid through said circuit as effected by the reciprocation of said friction rod, said circuit being free of association with any fluid motivating element other than said hollow friction rod.

14. In a full fashioned knitting machine having a hollow friction rod and means for reciprocating said rod, of a reservoir and connections forming a temperature modifying closed circuit with said rod having fluid therein and arranged to keep said rod filled therewith, valve means in said circuit arranged to control the direction of flow of fluid through said circuit as effected by the reciprocation of said rod, and siphon means for feeding fluid from said reservoir for circulating through said friction rod, said circuit being free of association with any fluid motivating element other than said hollow friction rod.

15. The combination with a hollow reciprocatively operated fluid motivating knitting machine member, of means connected with the ends of said hollow member establishing a temperature modifying closed fluid circuit therewith, fluid in said circuit, and a valve element connected in said circuit and arranged to be operated by the liquid in timed relation with the movements of said knitting machine member, said circuit being free of association with any fluid flow inducing element other than said machine member.

16. The combination with a hollow reciprocatively operated knitting machine member, of means connected with the ends of said hollow member establishing a temperature modifying closed fluid circuit therewith, fluid in said circuit, and a valve element connected in said circuit and arranged to cooperate with said knitting machine member so that it effects motivation of the liquid in said circuit, said circuit being free of association with any fluid flow inducing element other than said machine member.

17. The method of operating a machine having a hollow liquid containing motion translating member for causing a flow through stationary parts of a temperature modifying liquid circuit of which said motion translating member forms a portion, comprising periodically causing a flow in the liquid within said hollow member relatively thereto for a portion of its cycle of movement solely by momentum due to motion translating action thereof and preventing a comparable flow of the liquid relatively to the hollow reciprocating member due to motion translating action thereof for another portion of its cycle of movement to produce a net flow of liquid through said member in a predetermined direction.

18. The combination with a reciprocating liquid motivating machine member having a liquid filled conduit associated therewith and imparting momentum to the liquid therein due to the reciprocation of the member, of means connecting the ends of said conduit with said member and establishing a temperature modifying closed liquid filled circuit therewith, and a valve element connected in said circuit and arranged to be operated by the liquid in timed relation with the movements of said reciprocating machine member to check movement of liquid in one direction in said circuit due to said momentum and to permit movement of liquid in the other direction due to said momentum so that it induces flow of the liquid in one direction only in said circuit, said circuit being free of association with any fluid flow inducing element other than said machine member.

19. The combination with a reciprocating machine member having a liquid filled conduit associated therewith and imparting momentum to the liquid therein due to the reciprocation of the member, of means connected with the ends of said conduit establishing a temperature modifying closed liquid filled circuit therewith and a valve element connected in said circuit and arranged to check movement of liquid in one direction in said circuit due to said momentum and to permit movement of liquid in the other direction due to said momentum so that it induces flow of the liquid in one direction only in said circuit, said circuit being free of association with any flow inducing element other than said machine member.

CHARLES S. ASCHENBRENNER.