June 7, 1960 F. KREIENBÜHL ET AL 2,939,304

HYDRAULIC DRIVE MECHANISM FOR THE THREAD GUIDE RAILS OF FLAT COULIER KNITTING MACHINES

Filed Jan. 13, 1959 5 Sheets-Sheet 1

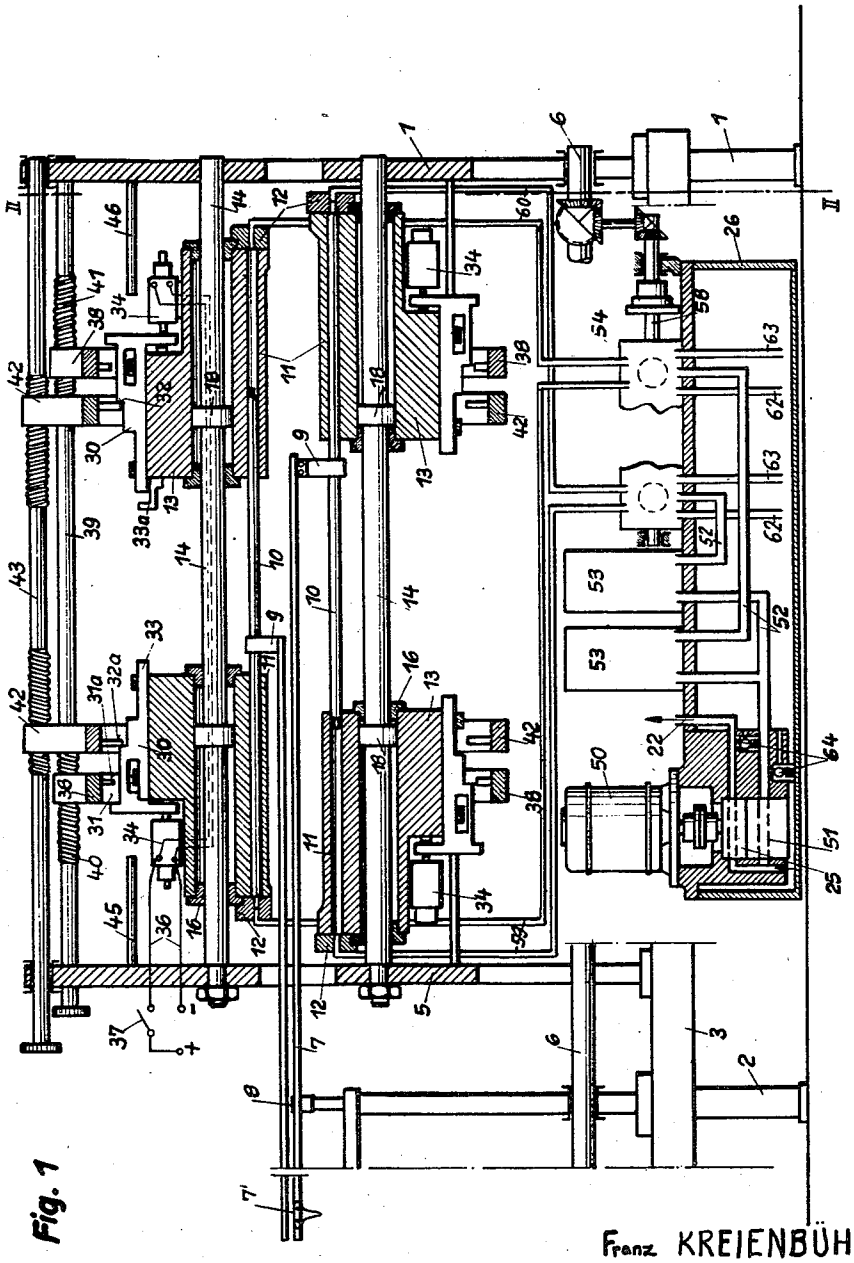


Fig. 1

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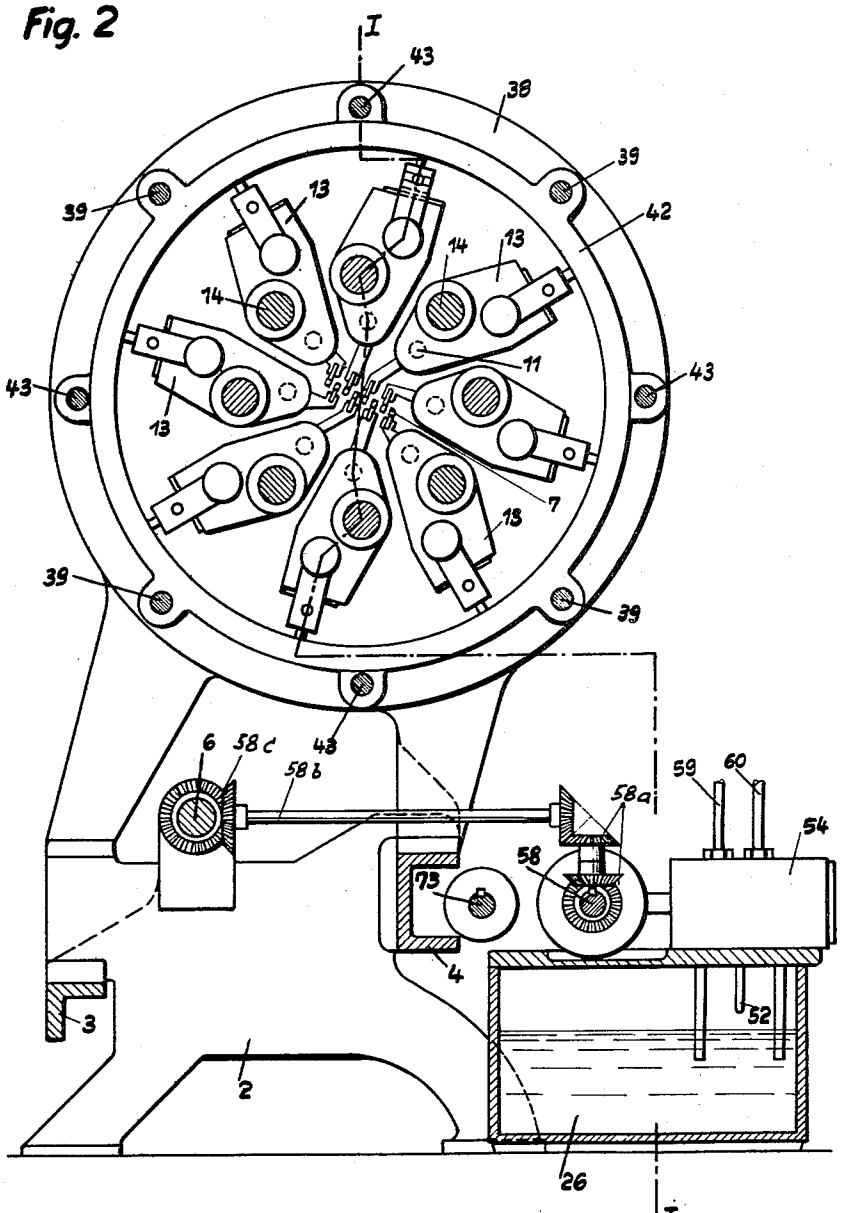
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Filed Jan. 13, 1959 5 Sheets-Sheet 2

Fig. 2




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Filed Jan. 13, 1959 5 Sheets-Sheet 3

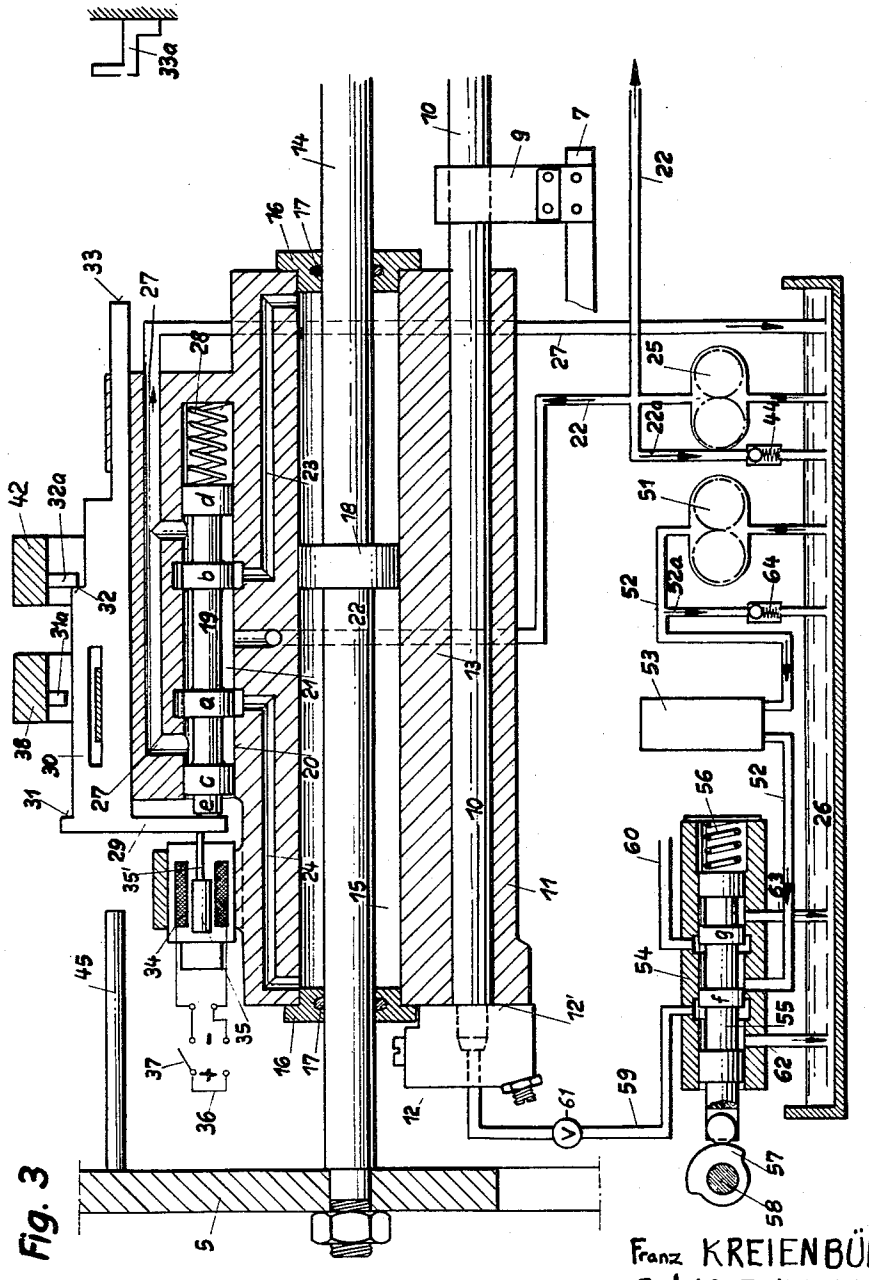


Fig. 3

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Filed Jan. 13, 1959 5 Sheets-Sheet 4

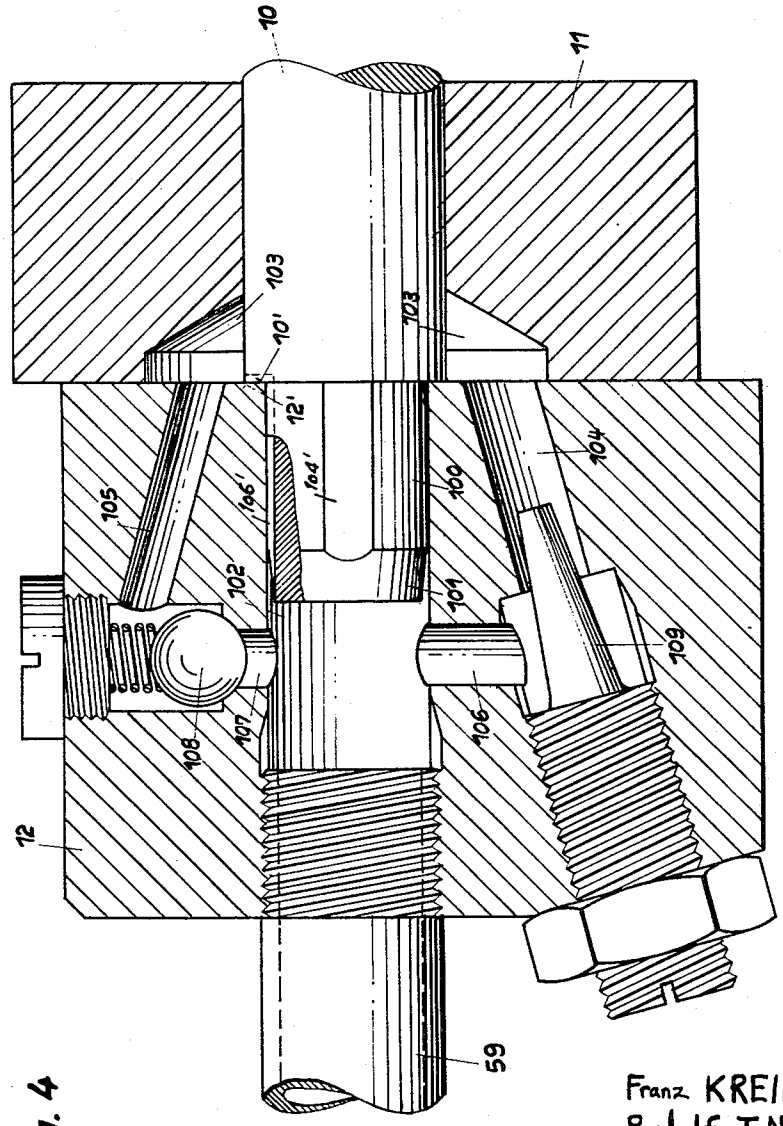



Fig. 4

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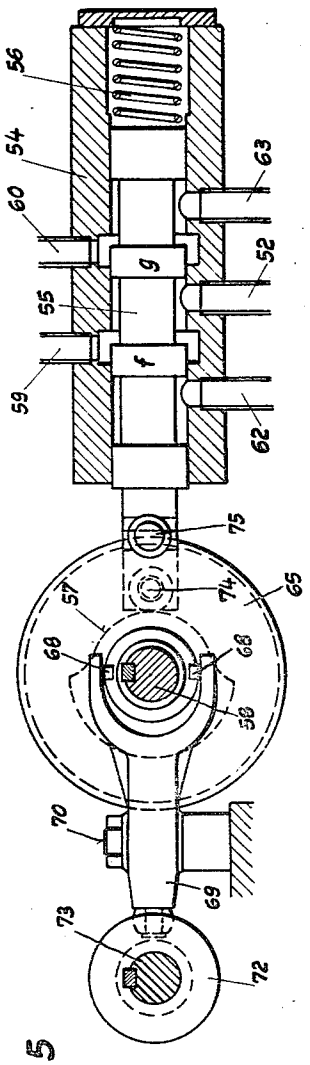



Fig. 5

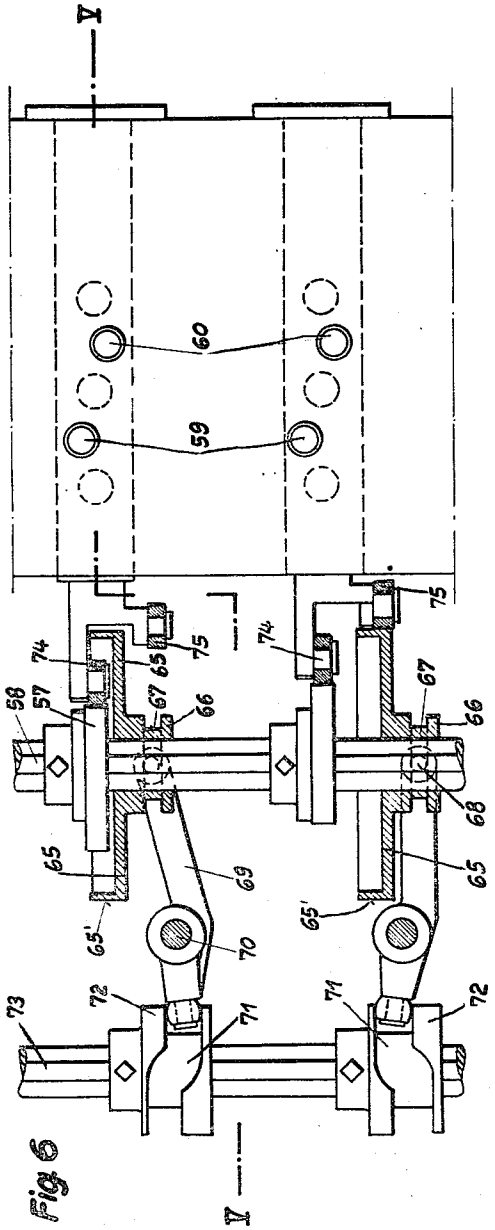



Fig. 6

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United States Patent Office 2,939,304 Patented June 7, 1960



2,939,304

# HYDRAULIC DRIVE MECHANISM FOR THE THREAD GUIDE RAILS OF FLAT COULIER KNITTING MACHINES

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Filed Jan. 13, 1959, Ser. No. 786,566

Claims priority, application Switzerland Jan. 16, 1958

5 Claims. (Cl. 66—126)

The present invention relates to a hydraulic drive mechanism for the thread guide rails of flat Coulier knitting machines having piston rods driving the thread guide rails the ends of which are guided each in a cylinder open at one end and supplied alternately with a pressure fluid.

The invention has the primary object of providing a mechanism of this kind, wherein the excessive stresses and consequent quick wear of the abutments limiting the stroke of the said thread guide rails and of any adjustment devices thereof are obviated.

With this and other objects in view which will become apparent later from the following description of a preferred embodiment of the present invention given by way of example with reference to the accompanying drawings, we provide a hydraulic drive mechanism for the thread guide rails of flat Coulier knitting machines, comprising in combination: a frame, hydraulic cylinders open at one end mounted longitudinally slidably in said frame, hydraulic pistons having piston rods slidably fitted into the said hydraulic cylinders, means for supplying hydraulic pressure fluid selectively to the said hydraulic cylinders, thread guide rails slidably mounted in the said frame and operatively connected to the said piston rods, means for separately axially adjusting the said individual cylinders, and stops provided in the said cylinders limiting the stroke of the said thread guide rails by the said piston rods abutting the same.

Preferably our new mechanism comprises a frame having fixed horizontal bars, cylinder blocks slidably mounted on the said bars, hydraulic servo-motors operatively connected to the said frame and cylinder blocks, respectively, and in operation shifting the said cylinder blocks individually along the said bars, hydraulic cylinders open at one end and having inlets and outlets for the hydraulic fluid at the other end arranged in the said cylinder blocks, control valves hydraulically connected to the said hydraulic cylinders, abutments adjustably mounted on the said frame and operating the said control valves, hydraulic pistons having piston rods slidably fitted into the said hydraulic cylinders, thread guide rails slidably mounted on the said frame and operatively connected both to the said piston rods and to the said adjustable abutments, and stops provided in the said cylinders limiting the stroke of the said thread guide rails by the said piston rods abutting the same.

Preferably also a slider member is shiftably mounted on each of the said cylinder blocks which member has abutment faces spatially staggered and each co-operating with one of the said adjustable abutments. A throttling device arranged in the outlet for the hydraulic fluid expelled from each of the said hydraulic cylinders by the hydraulic pistons thereof running in, the said throttling device becoming effective shortly before the end of the piston rod abuts the said stop in the said hydraulic cylinder. For example an extension of reduced diameter may be arranged at the inner end of each piston rod, and a



corresponding bore may be provided in the end face of the associated hydraulic cylinder into which the said extension runs towards the end of the inward stroke of the hydraulic piston into the said hydraulic cylinder, the said throttling device being then arranged in the drainage path of the hydraulic liquid from the said bore.

This arrangement provides an effective hydraulic damping device reducing the velocity of the reciprocating inertia masses before their impact on their stops. A further feature of the invention consists in the manner of the axial adjustment of the cylinders relative to one another whereby the stroke of the thread guide rails and accordingly the width of knitting are determined. The actual position of the cylinders is likewise hydraulically adjusted through the said servo-motor control valves, so that the abutments controlling the same are stressed only by the comparatively low force of a spring biasing the said control valve, and do not undergo any wear worth mentioning.

These and other features of our said invention will be clearly understood from the following detailed description given with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section on the line I—I of Fig. 2 of the drive mechanism as a whole;

Fig. 2 is a cross section on the line II—II of Fig. 1;

Fig. 3 is a longitudinal section on a larger scale of a cylinder block with driving cylinder, servo-cylinder and abutment valve;

Fig. 4 is a section of the cylinder head of a driving cylinder with the damping device for the abutting piston;

Fig. 5 is a section of a control valve on the line V—V of Fig. 6, and

Fig. 6 shows the driving device for the control valves.

The hydraulic drive mechanism for the thread carrier rods as a whole is fitted to the end of a normal flat Coulier knitting machine of which **1** represents one extreme transverse beam, **2** the second but extreme transverse beam of the frame, and **3** and **4**, respectively, represent two longitudinal beams thereof. An auxiliary transverse beam **5** of the frame serves for journalling the shafts and bars of the drive mechanism to be described hereinafter in more detail. Reference numeral **6** denotes the shaft of the main eccentric of the machine which is journalled in the usual manner in the transverse beams. The thread carrier rods **7** are mounted longitudinally slidably in holders **8** and are at one end rigidly connected to the piston rods **10** by means of connector lugs **9** (Fig. 3). The piston rods **10** are mounted at both ends in cylinders **11**, which are closed at their outer ends by cylinder heads **12**. Eight thread carrier rods **7** (Fig. 2) are provided in the machine of which each is connected to a piston rod **10** of its own. Each of these piston rods is mounted in two cylinders **11**, and each cylinder **11** is arranged in a cylinder block **13**. As shown in Fig. 2, eight such cylinder blocks **13** are grouped around the thread carrier rods **7** on each side. On the whole the drive mechanism comprises accordingly sixteen cylinder blocks **13**, of which two are mounted axially slidably on each servo-motor piston rod **14** (Fig. 1). These servo-motor piston rods **14** are in turn rigidly fixed in the transverse beams **1** and **5** of the frame.

Fig. 3 shows the construction of a cylinder block **13** on a larger scale, as well as diagrammatically the oil pumps, valves and oil pipes required for its displacement and for the driving of the piston rod **10**. The thread carrier rods **7** are driven by the periodical supply of pressure oil to one of the two cylinders **11**, as will be explained in more detail hereinafter. The piston rod **10** is thereby pushed out of the cylinder, and accordingly moves the thread carrier rod **7**. The limitation of the length of

stroke of the piston rod **10** and accordingly of the thread carrier rod **7** is effected by the piston rod **10** abutting in the opposite cylinder on stops **12'** in the cylinder head thereof. In order to make the path of the thread carrier rods adjustable at will, as required for example in the manufacturing of stockings, the cylinder heads **12** are mounted hydraulically shiftably on the servo-motor piston rods **14**. For this purpose each cylinder block **13** contains a longitudinal bore, which is designed as a servo-motor cylinder **15** and is closed at both ends by bushings **16** (Fig. 3). These bushings are sealed by packings **17** against the servo-motor piston rod **14**. The servo-motor cylinder **15** contains a servo-motor piston **18** rigidly connected to the servo-motor piston rod **14**. For the control of the oil supply to the servo-motor cylinder **15** a cylindrical slide valve **19** is provided which is mounted axially slidably in a valve bore **20**. This cylindrical slide valve has two control lands *a* and *b*, and two guide lands *c* and *d*. The control lands control the supply of oil to, and drainage from the oil ducts **23** and **24**, respectively. The oil is sucked from a central oil sump **26** by an electrically driven oil pump **25** and fed through a pressure pipe **22** into the space **21** between the control lands *a*, *b* of the cylindrical slide valve **19**. Depending on the position thereof, it flows through the duct **24** to the left hand side of the servo-motor cylinder **15**, whereby the cylinder block **13** as a whole is shifted to the left, while the oil enclosed in the right hand side of the servo-motor cylinder flows back through the duct **23** and the return pipe **27** into the sump **26**, or it flows to the right hand side of the servo-motor cylinder **15**, whereby the cylinder block **13** moves to the right and the oil contained in the left hand side half of the servo-motor cylinder flows back through the duct **24** and pipe **27** into the sump **26**. The valve bore **20** contains a spring **28** which tends to force the cylindrical slide valve out of the bore **20**, i.e. from the locking position shown in Fig. 3 towards the left. The cylindrical slide valve **19** bears with its head *e* against the tongue **29** of a slider member **30**. The latter is mounted slidably with a limited stroke parallel to the cylinder slide valve **19** on the cylinder block **13**. It has a number of steps offset in space the vertical faces **31**, **32**, **33** of which serve as abutment faces. On the cylinder block **13** moreover an electromagnet **34** is mounted, which contains an axially movable plunger armature **35**. An extension **35'** of the plunger armature contacts the tongue **29** directly opposite the point of contact of the head *e* of the cylindrical slide valve **19**. The coil of the magnet **34** is connected to a circuit **36** containing the switch **37**. The magnet of the opposite cylinder is also connected (Fig. 1) to the same circuit.

The abutment faces **31** of the slider member **30** co-operate with abutments **31***a*, which are fixed to abutment rings **38**. The abutment rings **38** are guided by four spindles **39**, which are rotatably journalled in the transverse beams **1** and **5**. The function of the spindles **39** corresponds to that of the usual centre narrowing spindle of the machine. On each spindle **39** there is provided a right hand screw thread **41** and a left hand screw thread **40**, which both engage into associated tapped bores in the abutment rings **38**. Upon rotation of the spindles **39** the abutment rings **38** and consequently the abutments **31***a* approach, or move away from, one another, depending on the sense of rotation. The abutments **32***a* are adjusted in exactly the same manner. The same are attached on abutment rings **42**, which are in turn guided by four spindles **43** each of which has likewise a right hand— and a left hand—screw thread. The spindles **43** operate in a manner corresponding to that of the conventional narrowing spindles.

The abutment **33** of the left hand side slider member **30** moreover co-operates with a fixed stop **33***a* on the right hand side cylinder block **13**.

The abutments **31***a* and **32***a* on the rings **38** and **42**, respectively, can be removed when not needed.



When allowing a left hand side cylinder block **13** to run towards the associated right hand side cylinder block until the abutment **33** abuts the counter stop **33***a*, the piston rod **10** and with it the thread carrier rod **7** can move to-and-fro only on a very short path, which is important e.g. for the production of welts or splicings or of decorative strips.

On the transverse beams **5** and **1**, respectively, moreover rigid end abutments **45** and **46**, respectively, for the slider member **30** are arranged, which are contacted by them when the cylinder blocks **13** are in their rest position and the associated thread carrier rods do not operate.

By the action of the servo-motor adjustment device for the cylinder blocks **13** the inertia forces occurring any time the piston rods **10** abuts the stops **12'** are transmitted by the liquid contained in the cylinder space **15** to the servo-motor piston **18** and by the servo-motor piston rod **14** to the machine frame. The abutment rings **38**, **42** mounted on the spindles **39** and **43** are loaded by the low force of the spring **28** of the cylindrical piston valve **19** only, and consequently are not liable to substantial wear.

The driving device for the piston rods **10** is designed as follows: an oil pump **51** driven by an electric motor **50** (Fig. 1) constantly feeds pressure oil through a pipe **52** and pressure accumulators **53** to a control valve **54**. The cylindrical slide valve **55** (Figs. 3 and 5) is subject to the bias of a preloaded spring **56** which forces it constantly against a control eccentric **57**, which is keyed to a control shaft **58**, which in turn is in driving connection with the shaft **6** of the main eccentric of the machine through the gearing **58***a*, the shaft **58***b* and the gearing **58***c*. The control eccentric **57** imparts to the slide valve **55** a periodical to-and-fro movement so that the two control lands *f* and *g* alternately clear the discharge ports to the pipes **59** and **60**, respectively, which pass pressure oil to the cylinder heads **12** and at the same time connect the non-pressurized lines **62** and **63** with the overflow into the oil sump **26**. The reciprocating movement of the slide valve **55** is so determined that the to-and-fro movements of the thread carrier rods **7** is carried out in the existing relationship to the other movements of the machine. The supply of pressure oil and accordingly the rate, at which the piston rod **10** is moved in the cylinder **11**, may be regulated for example by an adjustable pressure reduction valve **61** (Fig. 3) arranged in the line **59**. The run of the piston rod **10** from one abutment to the other takes place completely unhampered and as quickly as the oil pressure and oil quantity permit.

Until the reversal of the slide valve **55** the piston rod is forced at any time firmly against the stop **12'** by the oil pressure acting on the opposite end, so that it cannot perform any uncontrolled movements. Each of the eight pairs of cylinders **11** is provided with a control valve **54**, which may be switched on and off as required.

An embodiment of the switching on device for the control valves **54** is illustrated by way of example in the Figs. 5 and 6.

On the rotary control shaft **58** adjacent each control eccentric **57** a circular disc **65** is mounted which reaches bell-fashion over the control eccentric **57**. The eccentrics **57** are rigidly connected to the shaft **58**, while on the other hand the discs **65** can be axially shifted on the shaft **58** while rotating with it. On the collar **66** of the discs **65** an annular groove **67** is machined into which two pins **68** engage, which are fixed to the forked end of a two-armed lever **69**. The levers **69** are mounted pivotally about a pivot pin **70** fixed to the frame, and engage with their other ends into the slotted cams **71** of control discs **72**, which are in turn rigidly mounted on a control shaft **73**. When the control shaft **73** is turned e.g. by hand, the slotted cams **71** impart a rocking movement of the two-armed levers **69**. Thereby the discs **65** are axially shifted a certain distance on the shaft **58**. The slotted cams are so shaped, that the discs **65** can

assume two end positions, either quite closely to the control eccentric 57 so that the bell-shaped flange 65' encloses the eccentric, or removed a certain distance from the eccentric so that the same stands free. The two end positions of the discs 65 are illustrated in Fig. 6.

On the cylindrical slide valve 55 two rollers 74 and 75 are mounted. The roller 74 lies in alignment with the axis of the slide valve 55 and contacts the outer circumference of the eccentric 57 when the control valve concerned is switched on. The roller 75 is laterally offset from the axis of the slide valve and rests on the circular circumference of the disc 65, when the latter is in its end position remote from the eccentric 57. In this position the cylindrical slide valve is in its position corresponding to the largest stroke of the eccentric 57, i.e. in the position shown in Fig. 3, in which the pipe 60 is connected to the oil suply pipe 52.

When a certain thread carrier rod is to be put in operation, the control shaft 73 is turned in such a manner that the corresponding lever 69 shifts the disc 65 of the control valve 54 concerned into the switching on position, in which it covers the eccentric 57. The spring 56 then forces the slide valve 55 against the eccentric 57, which drives the same through the roller 74. The putting out of action of a thread carrier rod is effected by turning the control shaft 73 in such a manner, that the disc 65 is removed from the control eccentric 57. The outer circumference of the flange 65' then reaches under the roller 75 and retains the slide valve 55 in its right hand side end position in which the duct 60 leading to the right hand side half of the cylinder 11 is permanently under pressure. The corresponding piston rod 10 then can not move any longer but remains stationary at the stop 12' of the left hand side cylinder head 12. By the way, it should be mentioned that the control shaft 73 can be moved only when the shaft 58 rotates, since the discs 65 can be moved into the switching off positions only when the eccentric 57 forces the slide valve 55 into its right hand side end position.

An essential feature of the invention is the limitation of the thread carrier rod stroke or the stroke of the piston rods 10 driving the thread guide rails, respectively, by the heads of the piston rods abutting the end faces 12' of the cylinder heads 12. Since it is essential that the thread carrier rod should attain its end position without vibration, and that after the first impact of the piston rod 10 on the cylinder head no rebound may occur, the cylinder heads 12 are provided with a damping device for the abutting piston rod. Fig. 4 shows a cylinder head 12 on a larger scale. The piston rod 10 carries at its end a pin 100 of smaller diameter, which in turn has a conical taper 101 at its end. This pin engages into a bore 102 of the cylinder head 12 when the piston rod 10 runs into its end position. The bore of the cylinder 11 is enlarged at its juncture with the cylinder head 12, so that an annular space 103 is formed when the piston rod 10 is in its end position, as shown in Fig. 4. In this end position the piston rod 10 abuts with its shoulder 10' the face 12' of the cylinder head. In the cylinder head 12 two inclined bores 104 and 105 are provided, which connect the space 103 with two bores 106 and 107 issuing into the bore 102 of the cylinder head perpendicular to the axis of the piston rod. There issues also the oil duct 59 which establishes communication with the control valve 54. The bore 107 is obturated by a check valve 108 which permits only the supply of oil from the bore 102 into the space 103, but blocks the return flow of the oil in the opposite direction. The return flow of the oil from the space 103 into the bore 102 can, however, take place through the bores 104 and 106. The cross section area of the bore 104 is restricted by an adjustable throttle screw 109.

When now pressure oil enters into the bore 102 through the duct 59, the annular space 103 is immediately also put under pressure through the bore 107, check valve 108 and bore 105. Accordingly the entire cross section area of the piston rod 10 is put under pressure which contributes to a higher rate of acceleration thereof.



When on the other hand the piston rod 10 runs into the end position shown in Fig. 4 it pushes the oil contained in the bore of the cylinder directly into the bore 102 and into the duct 59, until the extension 100 enters into the bore 102. Thereafter the oil contained in the space 103 has to flow back through the bores 104 and 106. This return flow of the oil is, however, hampered by the needle valve 109, and thereby the velocity of the piston rod running in is reduced. By adjusting the needle valve 109 the end velocity of the piston rod 10 running in can be controlled at will.

The damping of the piston rod running in may be solved structurally in a somewhat simpler way, in that instead of the bores 104 and 106 in the cylinder head milled recesses 104' or grooves 106' are machined in the pin 100 which extend over the full length of the pin 100 up to or into the shoulder 10', or by adapting the clearance between the pin 100 and the bore 102. After the pin 100 running into the bore 102, the remainder of the oil is then forced from the cylinder bore through these milled recesses, longitudinal grooves or annular gaps into the space 102, whereby likewise a damping effect on the piston rod 10 is attained. This effect is, however, not variable, but has to be adjusted by appropriate dimensioning of the milled recesses, longitudinal grooves or clearance, to match requirements.

The functioning of the thread carrier rod drive mechanism is as follows: when a thread carrier rod 7 is to be put into action, the corresponding switch 37 is closed, whereby the two electromagnets 34 of the associated cylinder blocks 13 are energised, so that their plunger armatures 35 shift the slider member at the left hand side cylinder block towards the right, and at the right hand side cylinder block towards the left, out of their locking position and against the bias of the spring 28. The pressure oil supplied by the pump 25 then flows at both cylinder blocks through the pipe 22, the space 21 and the pipe 23 to the inside of the servomotor cylinders 15, and the two cylinder blocks move towards one another until one of the abutment faces 31 or 32 of the slider member 30 abuts the corresponding stop 31*a* or 32*a*. Thereby the slider member 30 is pushed into its locking position illustrated in Fig. 3, and the cylinder blocks 13 come to a standstill. The pressure oil supplied by the pump 25 then flows through the pipe 22*a* and the excess pressure valve 44 back into the oil sump 26. When the spindles rotate, the abutment rings of which are in contact with the slider members 30 (in Fig. 1 the spindle 43 and the abutment ring 42) in such a manner that the abutment rings 42 move away from one another, the slider members 30, too, move with the abutment rings out of their locking position and the two cylinder blocks follow up the movement of the abutment rings. When conversely the spindles rotate in such a manner, that the abutment rings approach one another the plunger armatures 35 of the electromagnets 34 move the slider members 20 out of their locking position, and the cylinder blocks 13 follow up the abutment rings, until their abutments have shifted again the slider member 30, and with it the cylindrical piston valve 19, into the locking position. However, the stops 31*a* and 32*a* on the left hand side abutment rings 38 and 42, respectively, may alternatively be put out of action by folding them down or removing them. It is then possible to move the left hand side cylinder block 13 towards the right hand side block until the abutment face 33 of the left hand side slider member 30 touches the stop 33*a* on the right hand side cylinder block 13, which is of importance for margin reinforcing thread carrier rods.

It is accordingly possible, to control selectively each of the eight thread carrier rods 7 at will, so that each

can be used for any manner of operation selected, for example as a ground thread carrier rod or as a welt or splicing thread carrier rod.

When a thread carrier rod has to be put out of action, the switch **37** is to be switched off. The spring **28** then pushes the cylindrical slide valve **19** and with it the slider member **30** and the plunger armature **35** out of the locking position shown in Fig. 3 towards the left. The pressure oil then flows through the duct **24** into the left hand side cylinder space **15**, and the cylinder block **13** moves to the left until the slider member **30** abuts the end stop **45**, and thereby moves the cylindrical slide valve **19** into its locking position. The right hand side cylinder block **13** runs in exactly the same manner to the right, until it has reached the stop **46**.

When after switching on the switch **37** a pair of cylinder blocks **13** bears in the working position on the corresponding stops **31***a* or **32***a*, by turning the shaft **73** into the appropriate working position the control valve **54** co-operating with this pair of cylinder blocks is switched on. The pressure oil supplied by the oil pump **51** is then fed by the cylindrical slide valve **55** of the control valve, in accordance with the run of the machine, alternately through the pipes **59** and **60** to the two cylinder heads **12**, while the oil displaced by the piston rod running in flows back to the oil sump **26** from that side of the cylinders, which is actually not under pressure, through the pipes **59** and **60**, respectively, the control valve **54**, and the return pipes **62** and **63**, respectively. The pressure accumulators are of the usual construction and are consequently illustrated diagrammatically only. They serve in the known manner for storing the pressure oil. When they are completely filled, the excess pressure valves **64** open, and the pump discharges through the pipe **52***a* directly into the oil sump **26**.

While we have herein described and illustrated in the accompanying drawings what may be considered a typical and particularly useful embodiment of our said invention, we wish it to be understood that we do not limit ourselves to the particular details and dimensions described and illustrated; for obvious modification will occur to a person skilled in the art.

What we claim as our invention and desire to secure by Letters Patent is:

1. A hydraulic drive mechanism for the thread guide rails of flat Coulier knitting machines, comprising in combination: a frame, hydraulic cylinders open at one end mounted longitudinally slidably on said frame, hydraulic pistons having piston rods slidably fitted into the said hydraulic cylinders, means for supplying hydraulic pressure fluid selectively to the said hydraulic cylinders, thread guide rails slidably mounted in the said frame and operatively connected to the said piston rods, means for separately axially adjusting the said individual cylinders, and stops provided in the said cylinders limiting the stroke of the said thread guide rails by the said piston rods abutting the said stops.

2. A hydraulic drive mechanism for the thread guide rails of flat Coulier knitting machines, comprising in combination: a frame having fixed horizontal bars, cylinder blocks slidably mounted on the said bars, hydraulic servomotors operatively connected to the said frame and cylinder blocks, respectively, to shift the said cylinder blocks individually along the said bars, hydraulic cylinders open at one end and having inlets and outlets for the hydraulic fluid at the other end arranged in the said cylinder blocks, control valves hydraulically connected to the said hydraulic cylinders, abutments adjustably mounted on the said frame and operating the said control valves, hydraulic pistons having piston rods slidably fitted into the said hydraulic cylinders, thread guide rails slidably mounted on the said frame and operatively connected to the said piston rods and regarding its stroke dependent from the position of the said adjustable abutments, and stops provided in the said cylinders limiting the stroke of the said thread guide rails by the said piston rods abutting the same.

3. A hydraulic drive mechanism as claimed in claim 2, comprising a slider member shiftably mounted on each of the said cylinder blocks and having abutment faces spatially staggered and each co-operating with one of the said adjustable abutments.

4. A hydraulic drive mechanism as claimed in claim 2, comprising a throttling device arranged in the outlet of the hydraulic fluid expelled from each of the said hydraulic cylinders by the hydraulic pistons thereof running in, the said throttling device becoming effective shortly before the end of the piston rod abutting the said stop in the said hydraulic cylinder.

5. A hydraulic drive mechanism as claimed in claim 4, comprising an extension of reduced diameter arranged at the inner end of each piston rod, a corresponding bore being provided in the end face of the associated hydraulic cylinder into which the said extension runs near the end of the inward stroke of the hydraulic piston into the said hydraulic cylinder, the said throttling device being arranged in the drainage path of the hydraulic liquid from the said bore.

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