Oct. 11, 1949. L. IVERSEN 2,484,347

FLUID OPERATED STRIP GUIDE

Filed May 22, 1946 7 Sheets-Sheet 1

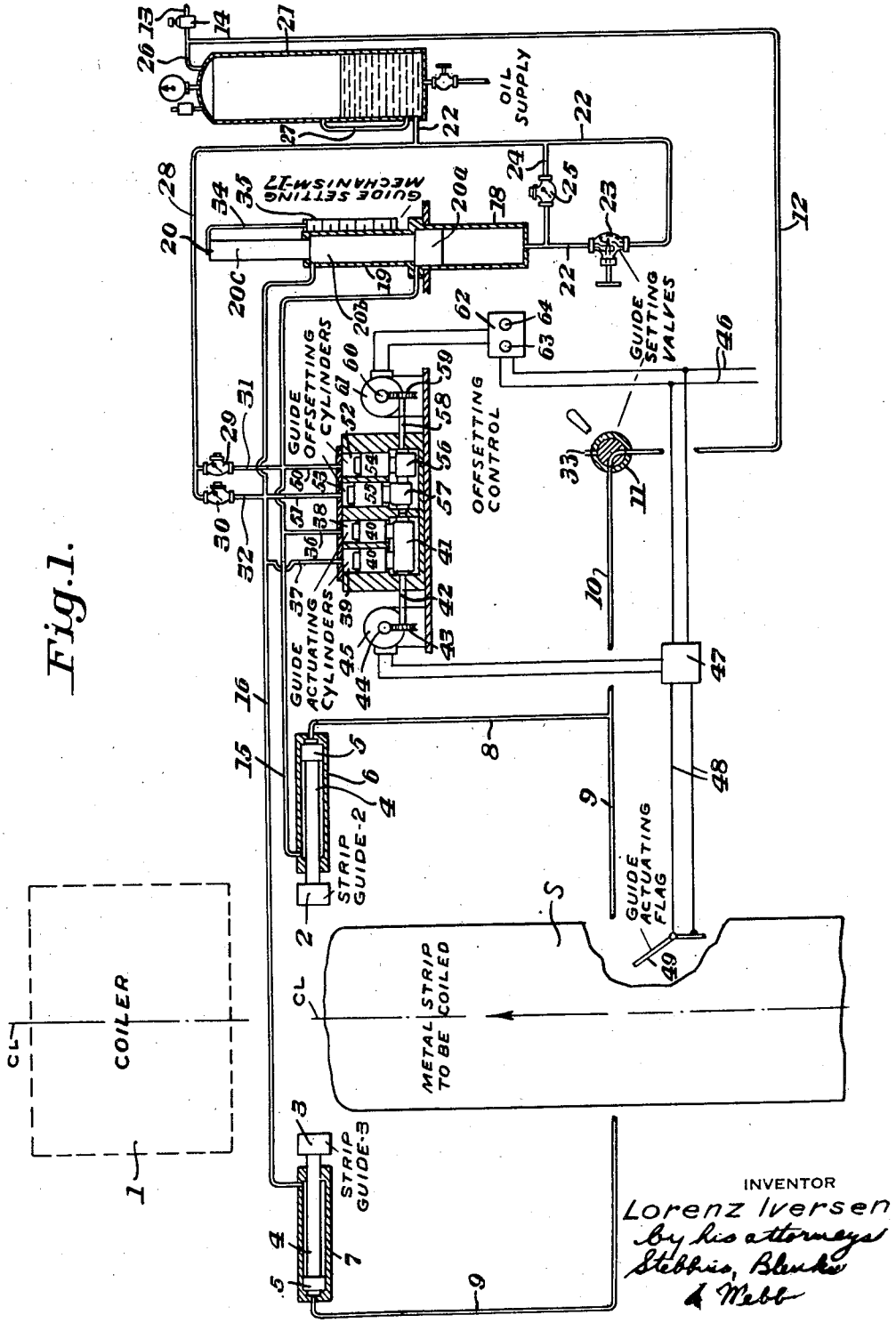


Fig. 1.

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FLUID OPERATED STRIP GUIDE

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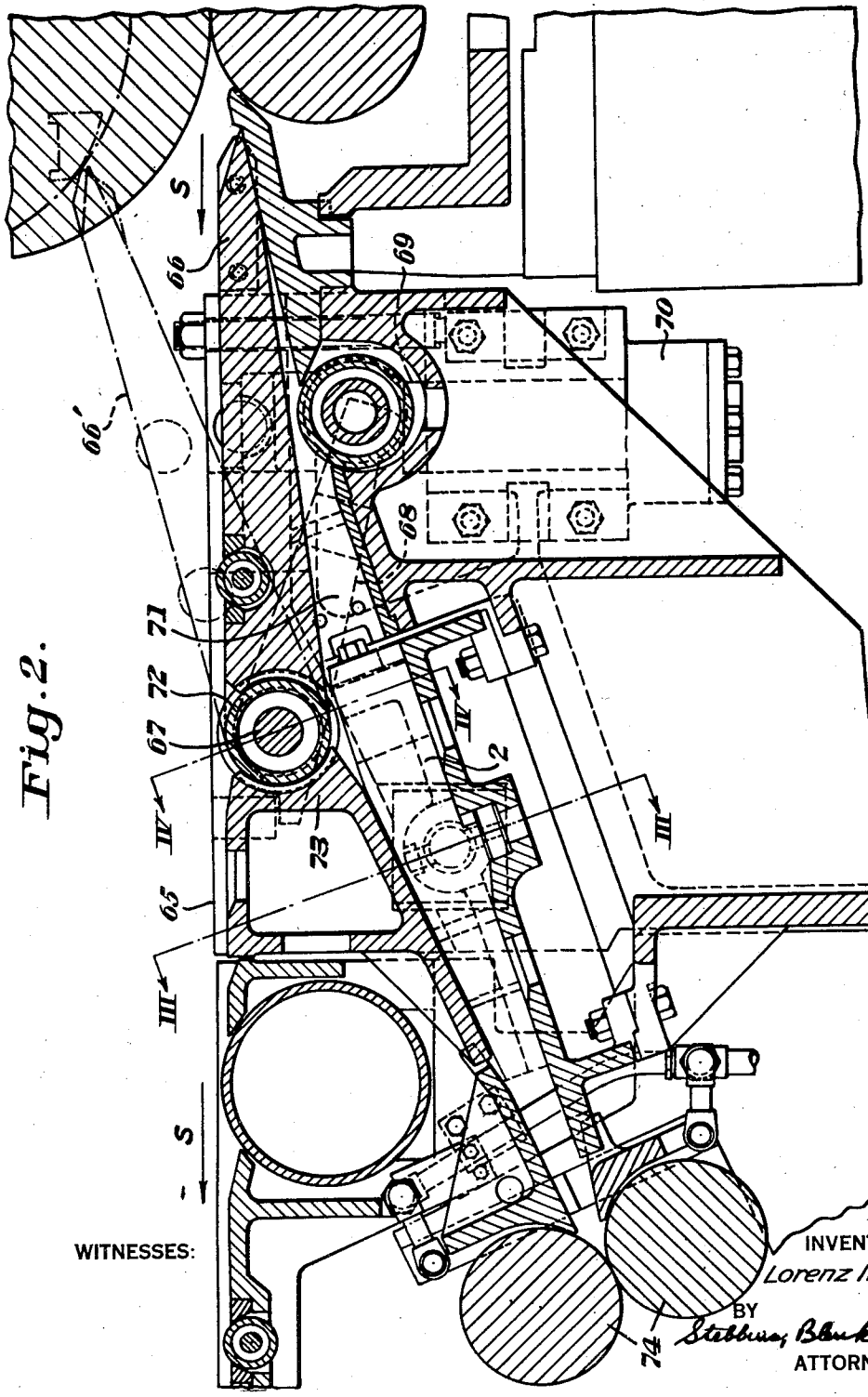


Fig. 2.

WITNESSES:

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Oct. 11, 1949. L. IVERSEN 2,484,347

FLUID OPERATED STRIP GUIDE

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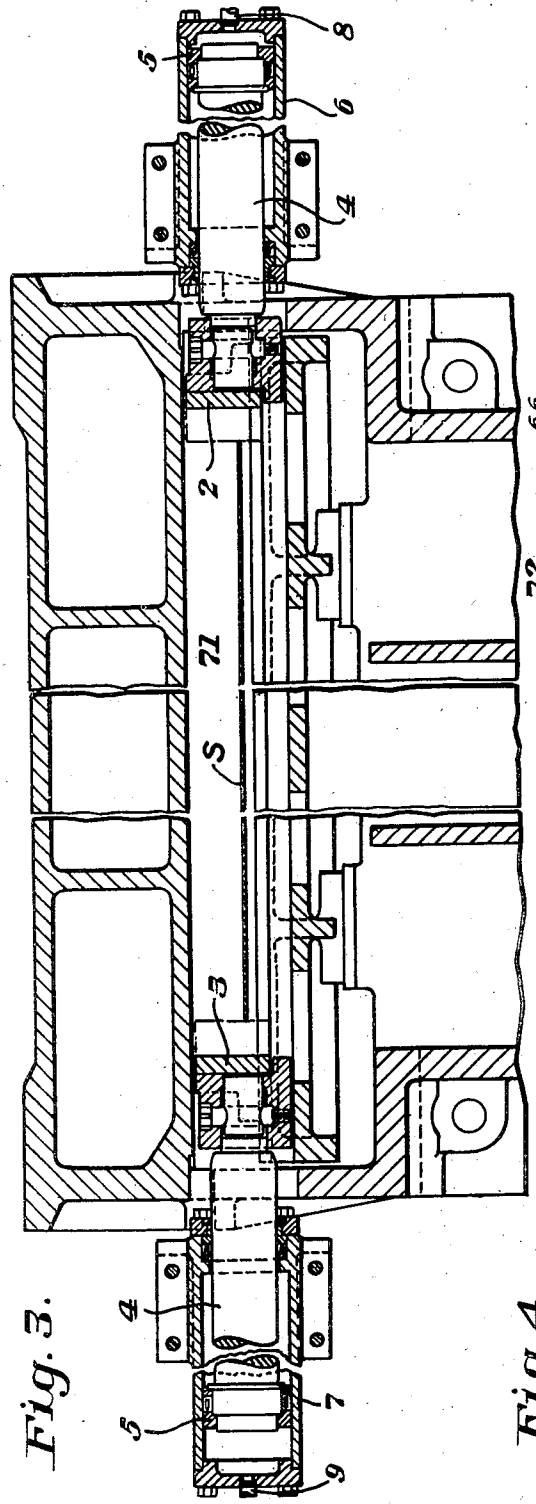


Fig. 3.

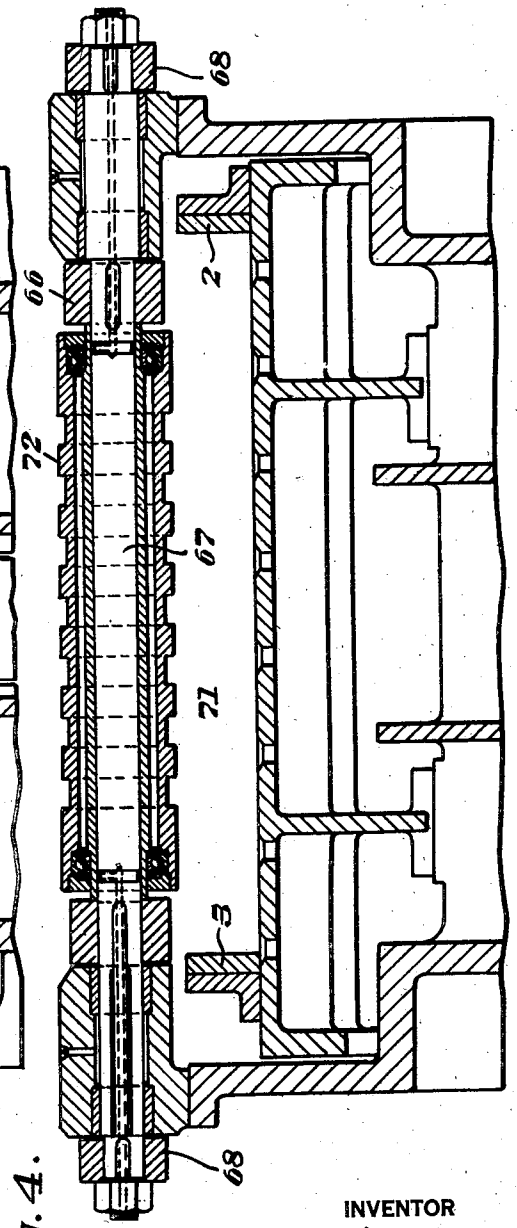


Fig. 4.

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Oct. 11, 1949. L. IVERSEN 2,484,347

FLUID OPERATED STRIP GUIDE

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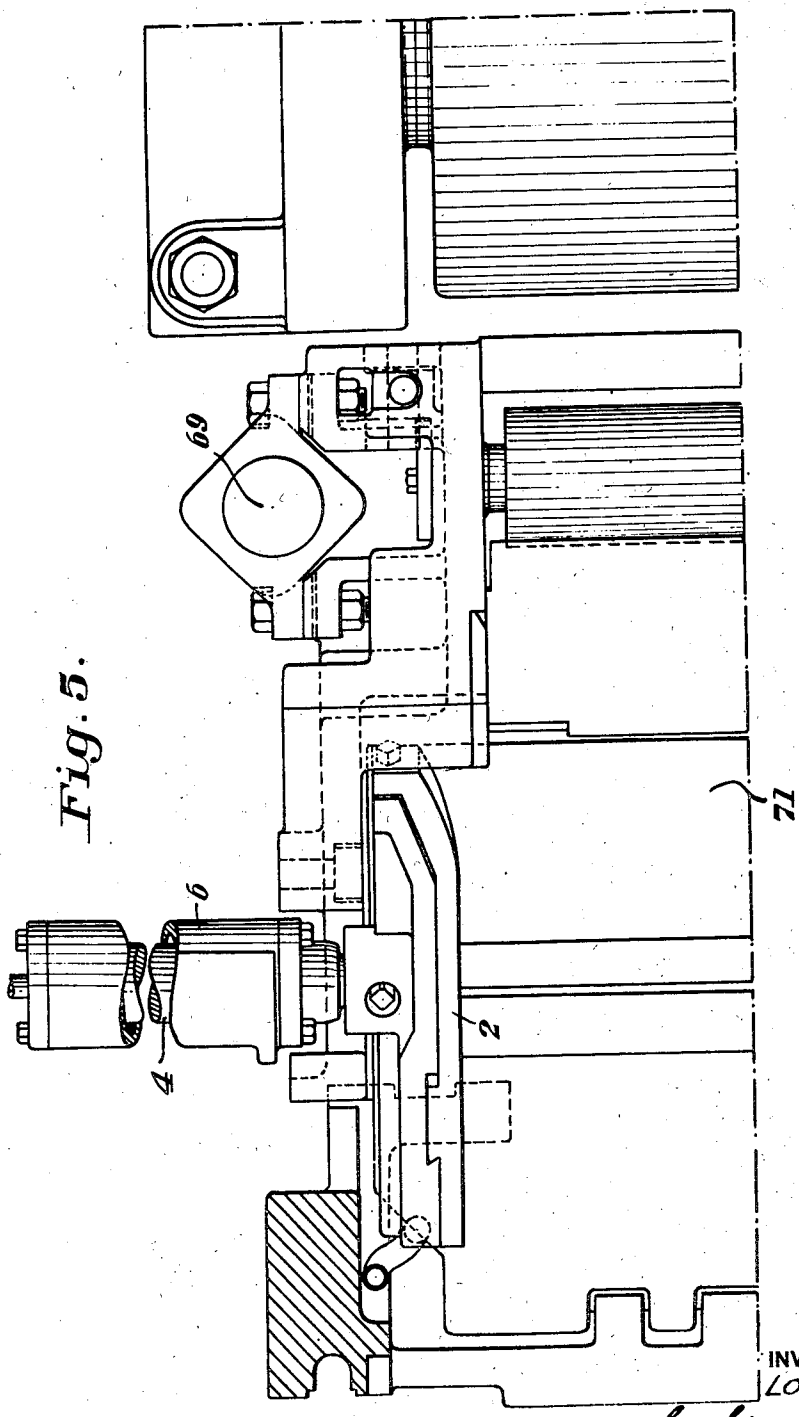


Fig. 5.

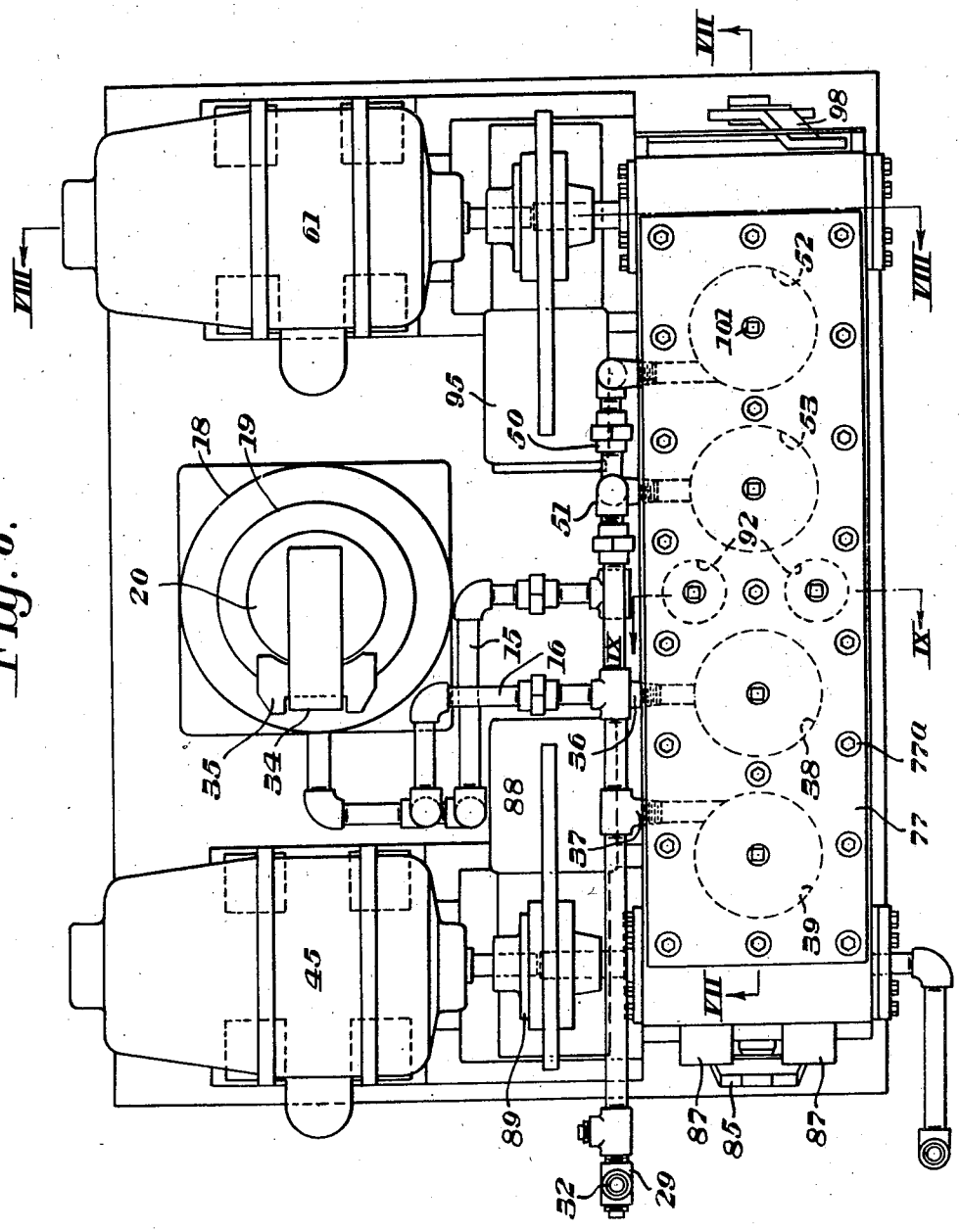
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FLUID OPERATED STRIP GUIDE

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Fig. 6.



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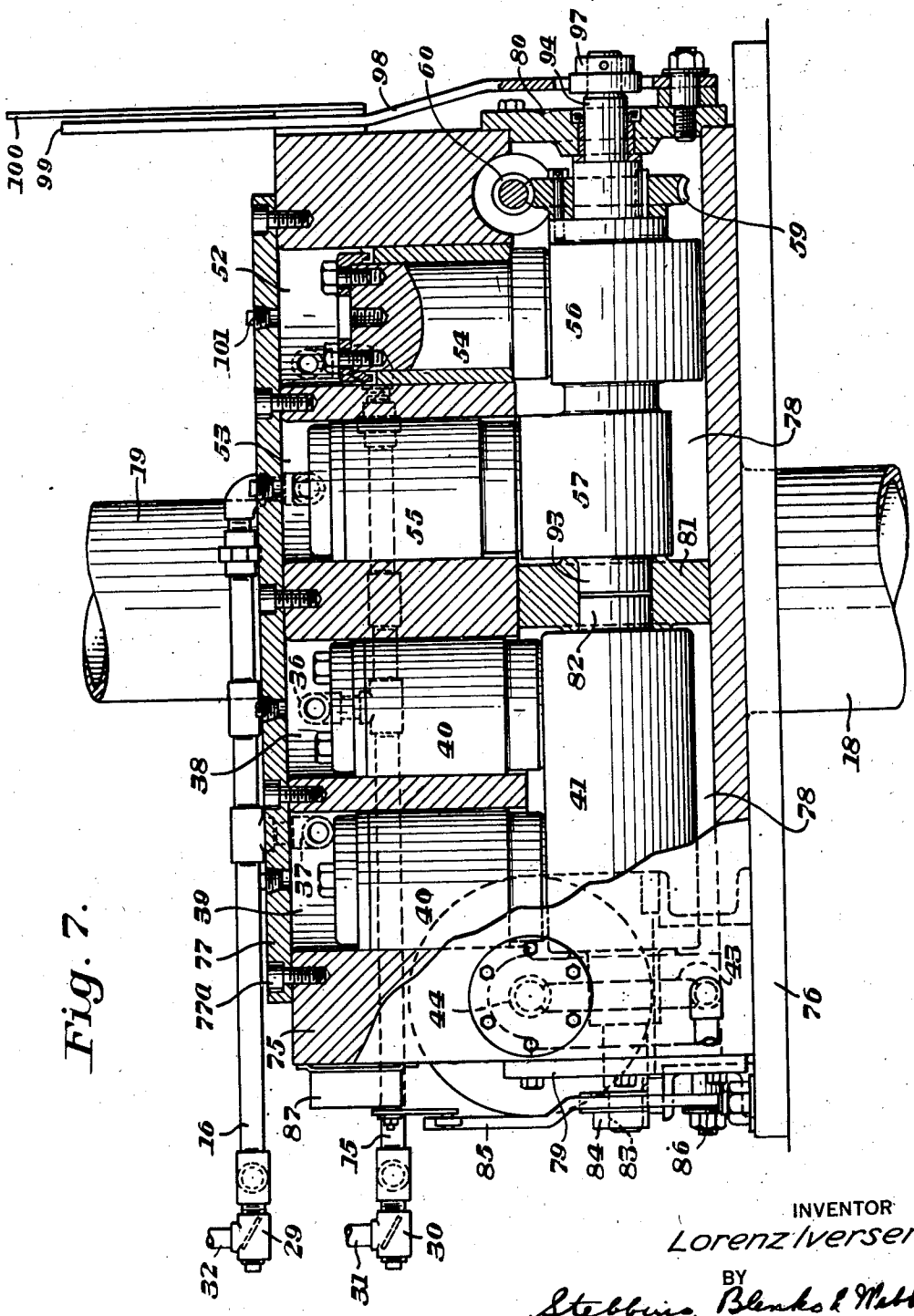


Fig. 7.

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FLUID OPERATED STRIP GUIDE

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Fig. 9.

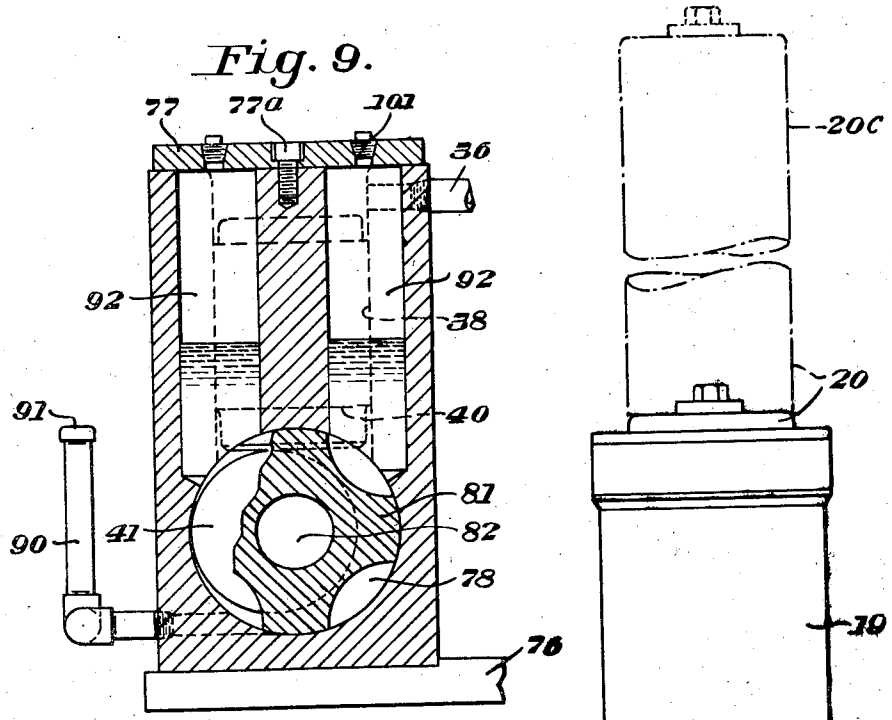
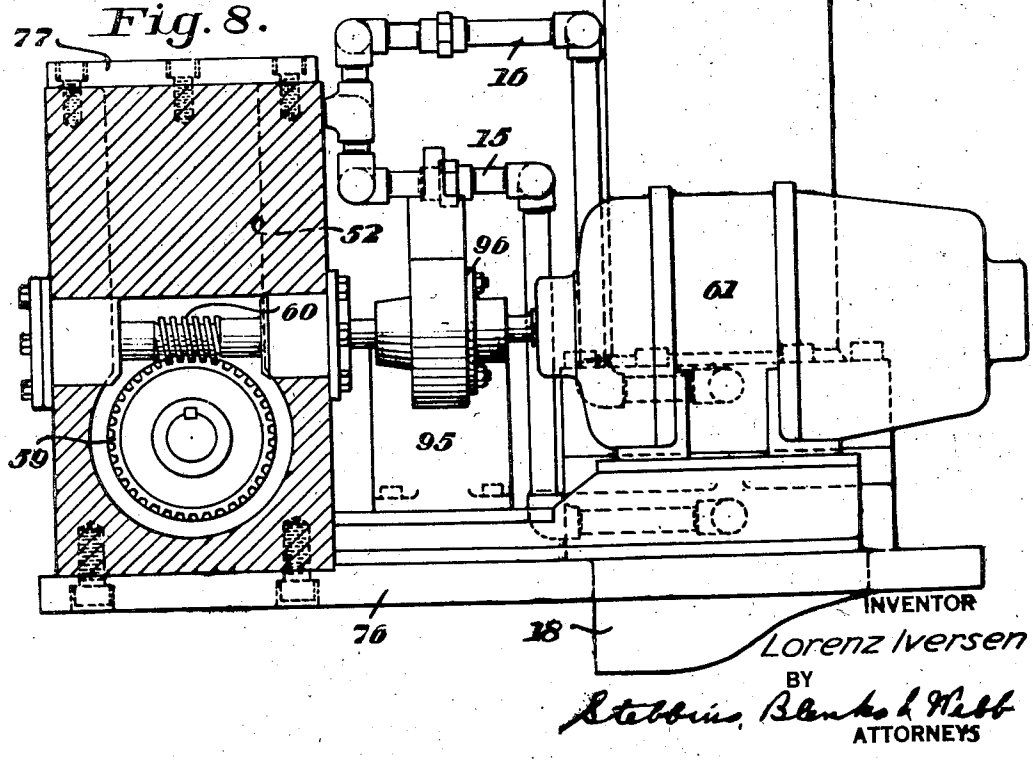


Fig. 8.



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Patented Oct. 11, 1949 2,484,347

UNITED STATES PATENT OFFICE

2,484,347

FLUID OPERATED STRIP GUIDE

Lorenz Iversen, Pittsburgh, Pa., assignor to Mesta Machine Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application May 22, 1946, Serial No. 671,562

7 Claims. (Cl. 271—2.6)

1

This invention relates to strip guides to be used, for example, in guiding hot metal strip to a coiler.

Paul Patent No. 2,111,054, dated March 15, 1938, discloses strip guides for use with a coiler, these guides being simultaneously adjustable toward or away from one another so as to accommodate different widths of strip and being also simultaneously movable toward and away from one another in any adjusted position so as to provide an open setting and a closed setting. My invention is an improvement over the Paul patent.

A common difficulty experienced with hot coilers is the tendency of the strip to "telescope" in the coil; that is to say, the ends of the coil instead of being plane are concave and convex. Telescoped coils are inconvenient or difficult to handle in subsequent processing, and battering of the strip edges with consequent loss frequently results.

I attribute the defect of telescoping principally to the presence of a small amount of "camber" in the hot rolled strip. By camber I mean a slight curvature of the strip in its own plane, so that if a long strip were laid out flat its center line would not be straight but would be curved. Camber may result from a slight over-rolling of the strip on one side. Even a very small amount of camber is likely to result in telescoped coils.

My invention makes it possible to eliminate telescoped coils, and apart from this it provides an improved and highly satisfactory guide setting and actuating mechanism.

In the accompanying drawings illustrating a present preferred embodiment of the invention,

Figure 1 is a diagram illustrating the side guides and the several controls therefor;

Figure 2 is a longitudinal vertical section through the entering guide mechanism of the coiler;

Figure 3 is a transverse section on the line of III—III of Figure 2;

Figure 4 is a transverse section on the line of IV—IV of Figure 2;

Figure 5 is a top plan view, partly broken away, showing the mechanism of Figure 2;

Figure 6 is a top plan view of the main guide actuating mechanism;

Figure 7 is a vertical section, partly in elevation, on the line of VII—VII of Figure 6;

Figure 8 is a vertical section, partly in elevation, on the line of VIII—VIII of Figure 6; and

Figure 9 is a vertical section on the line IX—IX of Figure 6.

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General arrangement and function

See particularly Figure 1.

Figure 1 diagrammatically illustrates a coiler 1 of conventional type, such as that illustrated in Figure 1 of the Paul Patent No. 2,111,054. A metal strip S to be coiled travels to the coiler in the direction of the arrow. Strip guides 2 and 3 are provided one on each side of the strip path. In Figure 1 these guides are shown positioned equidistant from the center line CL of the strip path and the coiler.

Provision is made for "setting" the strip guides 2 and 3; i. e., adjusting their spacing to accommodate strips of different widths. The setting of the guides is manually controlled.

Provision is further made for "actuating" the guides; i. e., moving their toward and away from one another in any set adjustment. This is done so that the guides may be spaced apart as the leading end passes to the coiler, and then moved toward one another to provide a spacing only slightly greater than the strip width so as to guide it properly. The actuation of the guides is strip-controlled and is automatic.

Provision is also made for "offsetting" the guides; i. e., positioning them asymmetrically with respect to the center line CL. This adjustment is manually controlled and will be made by the operator according to his visual observation of the coils being produced. The offsetting of the guides does not affect their spacing, nor does it affect their actuation. It does laterally shift the mid-point between the guides and hence the mid-point of the strip as it is presented to the coiler.

Guide setting.—The guides 2 and 3 are mounted on piston rods 4 having pistons 5 working in fluid cylinders 6 and 7 respectively. Movement of the guides toward one another is effected by compressed air operating back of the pistons 5. The compressed air is supplied through pipes 8 and 9 branching from a supply pipe 10 extending from a manually operated three-way control valve 11. When the valve is in the position shown in Figure 1, the valve 11 provides a pressure communication to the pipe 10 from a pressure pipe 12 leading from a supply line 13 through a pressure reducing and adjusting valve 14. The valve 14 functions to maintain a predetermined pressure in the pipe 12.

While air pressure is used to bias the guides 2 and 3 toward one another, a liquid, such as oil, is used to limit the amount of movement of the guides toward one another and to effect move-

ment in the opposite direction. The inner ends of the cylinders 6 and 7 are accordingly filled with oil and are connected by oil pipes 15 and 16 respectively to a guide setting mechanism indicated generally by the reference character 17. This mechanism comprises two cylinders 18 and 19 of different diameters and a stepped plunger 20 therein. The pipe 15 is connected to the top of the cylinder 18 and the pipe 16 to the top of the cylinder 19. In Figure 1 the plunger 20 is shown in its uppermost position and the guides 2 and 3 at their maximum opening. Neglecting the effect of the other mechanism for the moment and assuming the inner ends of the cylinders 6 and 7 and the pipes 15 and 16 full of oil, it will be seen that despite the pressure of the air on the rear ends of the pistons 5, the guides cannot move inwardly, the oil being incompressible. If now the stepped plunger 20 is lowered somewhat, an annular space will be provided in the upper end of the cylinder 18 by reason of the fact that the portion 20*a* of the plunger 20 will now be spaced from the top of the cylinder and the portion 20*b* which is of smaller diameter will be extending into the cylinder 18. This permits a corresponding quantity of oil to flow through the pipe 15. Air under pressure in the pipe 8 will then cause the guide 2 to move inwardly a distance corresponding to the volume of oil which flows out of the cylinder 6 to fill the annulus at the top of the cylinder 18.

A corresponding movement of the guide 3 is effected simultaneously by flow of oil through the pipe 16 into the top of the cylinder 19, the uppermost portion 20*c* of the stepped plunger 20 being of such diameter relative to the portions 20*a* and 20*b* as to insure that the oil-receiving annulus at the top of the cylinder 19 is of the same volume as that at the top of the cylinder 18.

It follows that the guides 2 and 3 may be set to any desired spacing by adjusting the vertical position of the plunger 20 and that vertical adjustment of the plunger 20 will cause equal adjustment of the guides.

The adjustment of the plunger 20 is controlled by the inflow or outflow of oil below the portion 20*a* of the plunger 20. The source of oil is a supply tank 21. A pipe 22, having a manually operated control valve 23 therein, connects the bottom of the tank 21 with the bottom of the cylinder 18. A cross connection 24, having a check valve 25 therein, is provided to bypass the valve 23. This check valve permits flow of oil to the cylinder 18 but prevents back-flow.

The tank 21 is connected at its top by a branch pipe 26 to the reducing valve 14 so that the same pressure is maintained on top of the oil in the tank 21 as is maintained in the air pipe 12. The tank 21 is further provided with a sight glass 27 so that the amount of oil can readily be observed. Oil may be added or withdrawn through a valved connection at the bottom of the tank, as shown.

A branch pipe 28 leads from the oil pipe 22 through check valves 29 and 30 and thence through pipes 31 and 32 respectively, connecting with the pipes 15 and 16 respectively. The check valves are used for filling the system. They permit the flow of oil into the pipes 15 and 16 but prevent back-flow.

The valve 11 has a relief port 33 whereby the air pipes 8, 9, and 10 may be vented to the atmosphere by turning the valve. If the pipes be thus vented, oil will flow into the bottom of the cylinder 18 through the check valve 25 and will raise the plunger 20 to its uppermost position and separate the guides to their maximum setting. Oil will also flow through the check valves 29 and 30 if the lines they feed are not wholly filled.

If, now, the valve 11 is returned to its normal illustrated position, a biasing pressure will be provided behind the pistons 5, but it will not be effective because the inner ends of the cylinder 6 and 7 and the pipes 15 and 16 will be completely filled with oil. If the valve 23 is now opened, the plunger 20 will commence to move downwardly. This movement will be due to two causes: First, while the air pressure in the pipes 8 and 9 will be the same as the oil pressure in the pipe 22, the effective area of the pistons 5 upon which the air acts is materially greater than the effective area upon which the oil acts (due to the diameter of the piston rods); second, the plunger 20 is very heavy. By manipulating the valve 23, the operator can thus effect the desired initial setting of the guides.

An indicator 34 is secured to the top of the plunger 20 and coacts with a gauge 35 to indicate the guide setting.

Guide actuating.—The pipes 15 and 16 are connected to branch pipes 36 and 37 respectively, communicating with the upper ends of fluid cylinders 38 and 39 respectively. Each of these cylinders contains a plunger 40 resting on an eccentric 41. Rotation of the eccentric 41 a half turn permits the plungers 40 to move downwardly in their cylinders and the reverse movement raises them to their topmost position. The eccentric 41 is carried on a shaft 42 carrying a worm wheel 43 meshing with a worm 44 on the shaft of a motor 45. The motor 45 is supplied with current from power lines 46 leading to a control indicated diagrammatically at 47. A pair of wires 48 extend from the control 47 to a flag switch 49 in the path of the oncoming strip S. The mechanism in the control 47, whose electrical details form no part of the present invention, serves to actuate the motor 45 so as to rotate the eccentric 41 a half turn, thereby causing lowering of the plungers 40 when the strip trips the flag 49. It further serves to actuate the motor so as to restore the plungers 40 to their initial raised position after the strip has passed over the flag 49. The effect of the first movement is to provide additional volume in the oil systems for each of the guides so that under the pressure of air supplied through the pipes 8 and 9, oil is forced from the cylinders 6 and 7 into the cylinders 38 and 39 respectively, thus causing the guides to move together from their set position. The second movement of the eccentric 41 causes the plungers 40 to force oil from the cylinders 38 and 39 back to the cylinders 6 and 7 respectively, thus opening the guides after the strip has passed and leaving them spread apart to permit the free entry of the leading end of the next strip.

By reason of the fact, heretofore noted, that the effective area of the outer end of the pistons 5 is greater than the effective area of their inner ends, the unit pressure in the pipes 15 and 16 will remain greater than the unit pressure in the pipe 28 and consequently no oil will enter through the check valves 29 and 30. In other words, so long as the valve 11 is maintained in the illustrated setting, the oil in the pipes 15 and 16, the cylinders 6 and 7 and the cylinders 38 and 39 will be to all intents and purposes contained in two closed systems.

The displacement volume of the cylinders 38 and 39 will be such as to provide a suitable, rela-

tively short opening and closing stroke for each guide, say 2¾".

By reason of the mechanism so far described, the initial setting of the guides may be determined by manipulating the valves 11 and 23 and the guides will stroke inwardly and outwardly from the set position whenever the motor 45 is actuated by the opening or closing of the flag switch 49 under the influence of a strip. It will be understood that the switch 49 must be spaced a suitable distance from the guides 2 and 3 to insure that the leading end of the strip S will have entered the guides before they move inwardly. Alternatively, a time control mechanism can be employed in the control 47.

Offsetting control.—An asymmetric setting of the guides 2 and 3 with respect to the center line CL is effected by substantially simultaneously increasing the volume of the closed oil system for one of the guides and decreasing the volume of the closed oil system for the other guide. To this end, the pipes 15 and 16 are provided with additional branches 50 and 51 leading to the tops of cylinders 52 and 53 respectively. These cylinders contain plungers 54 and 55 respectively, which are actuated by eccentrics 56 and 57 respectively. The throws of the two eccentrics are 180° apart. They are both mounted on a shaft 58 carrying a worm wheel 59 meshing with a worm 60 on the shaft of a motor 61. The motor is connected to a control box 62 having push buttons 63 and 64 so that it may be rotated in either direction to a desired extent. Actuation of the motor 61 displaces oil from one or the other of the cylinders 52 and 53, depending upon the direction of rotation, and permits lowering of the plunger in the other cylinder with consequent permitted increase of volume. Assuming that the plunger 54 has been moved upwardly, the result will be to force oil through the pipe 15 into the cylinder 6, thus moving the guide 2 to the right, as viewed in Figure 1. (It will be understood that the maximum opening of the guides 2 and 3 is greater than that necessary for any strip width to be handled and consequently that the offsetting control will not be employed except when the pistons 5 are at some initially adjusted position intermediate the ends of the cylinders 6 and 7.) As the plunger 54 is moved upwardly, the plunger 55 moves downwardly by reason of the flow of oil through the pipe 16 from the cylinder 7, thus causing the guide 3 to move to the right simultaneously with the guide 2 and in a similar amount. The initial setting of the guides 2 and 3 will thus be shifted to the right with respect to the center line CL. Actuation of the motor 61 in the opposite direction will cause offsetting of the guides to the left. The midpoint of the guides may thus be shifted as desired.

Guide structure

See particularly Figures 2 to 5 inclusive.

For illustrative purposes, I have shown a guide mechanism for a down-coiler; i. e., a coiler which lies below the plane of travel of the oncoming strip. Coilers of this sort are frequently arranged in tandem, as shown in Paul Patent No. 2,111,054, and used alternately. In Figure 2 the run-out table 65 is shown with a gate 66 rockable on a shaft 67 which carries actuating arms 68 extending over the plungers 69 (see Figure 5) of lifting cylinders 70. The strip travels in the direction of the arrows S. When it is desired to feed strip to the coiler supplied by the guide

mechanism of Figure 2, the gate 66 is raised to its dotted line position 66', thereby deflecting the oncoming strip into the throat 71 of the coiler.

A serrated roller 72 intermeshes with notches in the gate 66 and the table member 73 to prevent any possible escape of the leading end of the strip from the throat 71.

After the strip passes the guides 2 and 3, it travels between the pinch rolls 74 of the coiler.

In Figure 3, I have shown the guides 2 and 3 initially offset to the right, as will appear from the relative positions of the pistons 5 and the outer ends of their cylinders 6 and 7. The offsetting is also readily noticeable in Figure 4. I have also shown by dot-and-dash lines in Figure 3 the amount of movement of each guide upon actuation of the flag 49.

Guide actuating mechanism

See particularly Figures 1, 6, 7 and 9.

The cylinders 38 and 39 are bored in a cylinder block 75 which is mounted on a base plate 76 that supports the guide setting mechanism 17 (cylinders 18, 19 and associated mechanism) and the motors 45 and 61. The tops of the cylinders are closed off by a cover plate 77 secured to the cylinder block by cap screws 71*a*.

The cylinder block 75 is horizontally bored, as indicated at 78, to accommodate the eccentric 41. The ends of the bore 78 are closed off by cover plates 79 and 80. A bearing block 81 having a push fit in the bore 78 is located intermediate the two ends and forms the inner bearing 82 for the eccentric 41. The outer bearing is formed in the cover plate 79. The worm wheel 43 is keyed to the shaft 42 of the eccentric 41 and meshes with the worm 44 of the motor 45. The shaft 42 has a portion 83 projecting outside the cover plate 79 and carrying an eccentric 84 which coacts with an arm 85 pivoted at 86 and actuates limit switches 87, forming a part of the control mechanism indicated diagrammatically at 47 in Figure 1 for controlling the motor 45.

The motor 45 is additionally provided with a brake 88 working on a drum 89 so as to prevent motor drift and insure accurate control.

In Figure 7 the rams 40 are shown in an intermediate position. The motor 45 will be so controlled and actuated as to cause a 180° rotation of the eccentric 41, first in one direction and then in the other, so as to raise or lower the two rams 40 simultaneously, thus effecting inward or outward stroking of the guides as described in connection with Figure 1.

In order to eliminate the leakage of oil from the cylinders, the bore 78 is kept filled with oil. A filler pipe 90 having a sealing cap 91 (Figure 9) permits of supplying oil as required, and sealing the filled oil within the apparatus.

Since the downward movement of the rams 40 necessarily displaces some oil from the bore 78, provision must be made for accommodating the oil displaced. For this purpose, two expansion chambers 92 are formed in the cylinder block 75 at its mid-section. These bores intersect the bore 78 at their bottoms, as best shown in Figure 9, and the bearing block 81 is made cruciform in section so as to permit free travel of oil to and from either side of the block 81 and to and from the expansion chambers 92. When the rams 40 move downwardly they displace oil into the expansion chambers 92 and compress the air that is trapped thereabove.

Guide offsetting mechanism

See particularly Figures 1 and 6–9 inclusive.

The offsetting cylinders 52 and 53 are formed in the right hand half of the cylinder block 75 as it is viewed in Figure 7. The shaft 58 for the eccentrics 56 and 57 is provided with an inner bearing 93 in the bearing block 81 and an outer bearing 94 in the cover plate 80. The connection of the motor 61 with the eccentrics through the worm wheel 59 and the worm 60 is best illustrated in Figures 7 and 8.

The motor 61 is provided with a brake 95 operating on a drum 96 so as to prevent drift of the motor 61 after the current has been cut off.

The shaft 58 projects outside the cover plate 80 and carries a cam 97 which actuates an indicating lever 98. The lever 98 terminates in an indicating pointer 99 which traverses an indicating dial 100 suitably graduated to show the amount of offsetting for any adjusted position of the rams 54 and 55.

Each of the cylinders 38, 39, 52 and 53 and the expansion chambers 92 is provided with a vent plug 101 for bleeding air from the system as required.

Operation

While it is believed that the operation of the apparatus will be clear from the foregoing description, it will be recapitulated briefly.

The valve 23 will be opened and oil bled from the cylinder 18 until the pointer 34 and gauge 35 indicate a guide setting of the proper width for the strip to be coiled. Successive strips will then be fed to the coiler, each coil being ejected in known manner after it has been formed. Each strip as it passes to the coiler will actuate the flag 49. At this time the guides 2 and 3 will be spaced a distance greater than the strip width. When the flag 49 is tripped, the rams 40 will be lowered in their cylinders by the operation of the motor 45, thus bringing the guides closer together and spacing them at a distance corresponding to the strip width (it will be understood, of course, that the setting contemplates a small clearance). The closing of the guides will not be completed until after the leading end of the strip has entered the guiding zone.

If the operator observes that the coil is telescoping, he will actuate the push button control 62 and offset the guides laterally in one direction or another so as to eliminate it. This may be done during coil formation or between coils as he may desire.

After the trailing end of the strip has passed the flag 49, the motor 45 automatically operates in the reverse direction and raises the rams 40 to their topmost position, thereby opening the guides to permit the entering of the next strip.

Save for adjusting the guides to the proper strip widths, and manually adjusting the offsetting control to meet conditions as they arise, the operation is automatic.

My invention has many advantages. It provides an accurate and close control which functions under the most severe mill conditions. The telescoping of coils with consequent likelihood of damage to the strip edges and defect in subsequent processing may be overcome. The actuating and controlling mechanism is of such character that it may be conventiently located for ready access and most satisfactory operation. By reason of the fact that the control mechanism is connected to the strip guides only by oil- and air-lines, its position relative to the guides may be altered as desired, thus giving the mill designer more latitude. The mechanism is adaptable to a wide variety of uses.

I have illustrated and described a present preferred embodiment of the invention as applied to a down coiler for hot strip. It will be understood however, that this is by way of illustration only and that the invention may be otherwise embodied within the scope of the following claims.

I claim:

1. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, means for biasing the guides toward one another, a variable-volume liquid-pressure means for each guide for moving it in opposition to its biasing means, means for substantially simultaneously increasing and decreasing the volume of liquid in the two liquid-pressure means, thereby to effect a guide setting, and means for differentially adjusting the volume of liquid in the two liquid-pressure means, thereby to effect lateral offsetting of the guides.

2. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, variable-volume liquid-pressure means for moving the guides, variable-volume liquid-receivers connected thereto, means for simultaneously adjusting the effective volume of the receivers so as to effect a setting of the guides, means for supplementally varying the effective volume so as to effect movement of the guides, and means for substantially simultaneously adding liquid to one of said systems and withdrawing liquid from the other thereby to effect lateral offsetting of the guides.

3. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, a pair of variable-volume liquid-pressure means, one for each guide, for moving the same, variable-volume liquid-receivers connected thereto, means for simultaneously adjusting the effective volume of the receivers so as to effect a setting of the guides, means for supplementally varying the liquid volumes so as to effect movement of the guides, and means for substantially simultaneously increasing one volume and decreasing the other volume.

4. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, means for substantially constantly urging the guides toward one another, a variable-volume liquid-pressure means for each guide for moving it in opposition to the first-mentioned means, a volume-changing means for each of said liquid-pressure means for increasing or decreasing the liquid volume thereof, and means controlled by the strip for actuating the volume-changing means.

5. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, means for substantially constantly urging the guides toward one another, a variable-volume liquid-pressure means for each guide effective upon a change in the volume of liquid therein to coact with the guide urging means and effect a movement of the guide corresponding in amount to the change in liquid volume, a guide setting device consisting of means for substantially simultaneously changing the volume of liquid in each of the liquid pressure means, a guide-opening and -closing device consisting of a supplemental volume-changer for each of the liquid-pressure means adapted to increase or decrease the liquid volumes by an increment corresponding to a desired guide-opening or -closing move-

ment, and means controlled by the strip for actuating the supplemental volume-changers.

6. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, means for substantially constantly urging the guides toward one another, a variable-volume liquid-pressure means for each guide effective upon a change in the volume of liquid therein to coact with the guide urging means and effect a movement of the guide corresponding in amount to the change in liquid volume, a guide setting device consisting of means for substantially simultaneously changing the volume of liquid in each of the liquid pressure means, a guide-opening and -closing device consisting of a supplemental volume-changer for each of the liquid pressure means adapted to increase or decrease the liquid volumes by an increment corresponding to a desired guide-opening or -closing movement, and means controlled by the strip for substantially simultaneously actuating the supplemental volume changers.

7. Mechanism for guiding a metal strip comprising a pair of oppositely disposed side guides, means substantially constantly urging the guides toward one another, a guide-operating cylinder-and-piston means for each guide for limiting the action of the first-mentioned means and effecting movement of the guides in opposition thereto, a first pair of cylinders, one operatively connected to one of the guide-operating cylinders and the other operatively connected to the other guide-operating cylinder, means for substantially simultaneously adjusting the effective volume of each of the said first pair of cylinders thereby to effect a setting of the guides, a second pair of cylinders, open operatively connected to one of the guide-operating cylinders and the other operatively connected to the other guide-operating cylinder, and means for substantially simultaneously adjusting the effective volume of each of the said second pair of cylinders thereby to effect guide opening or closing.

LORENZ IVERSEN.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,484,347 **October 11, 1949**

LORENZ IVERSEN

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 26, for "71a" read *77a*; column 10, line 10, for the word "open" read *one*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of January, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.