

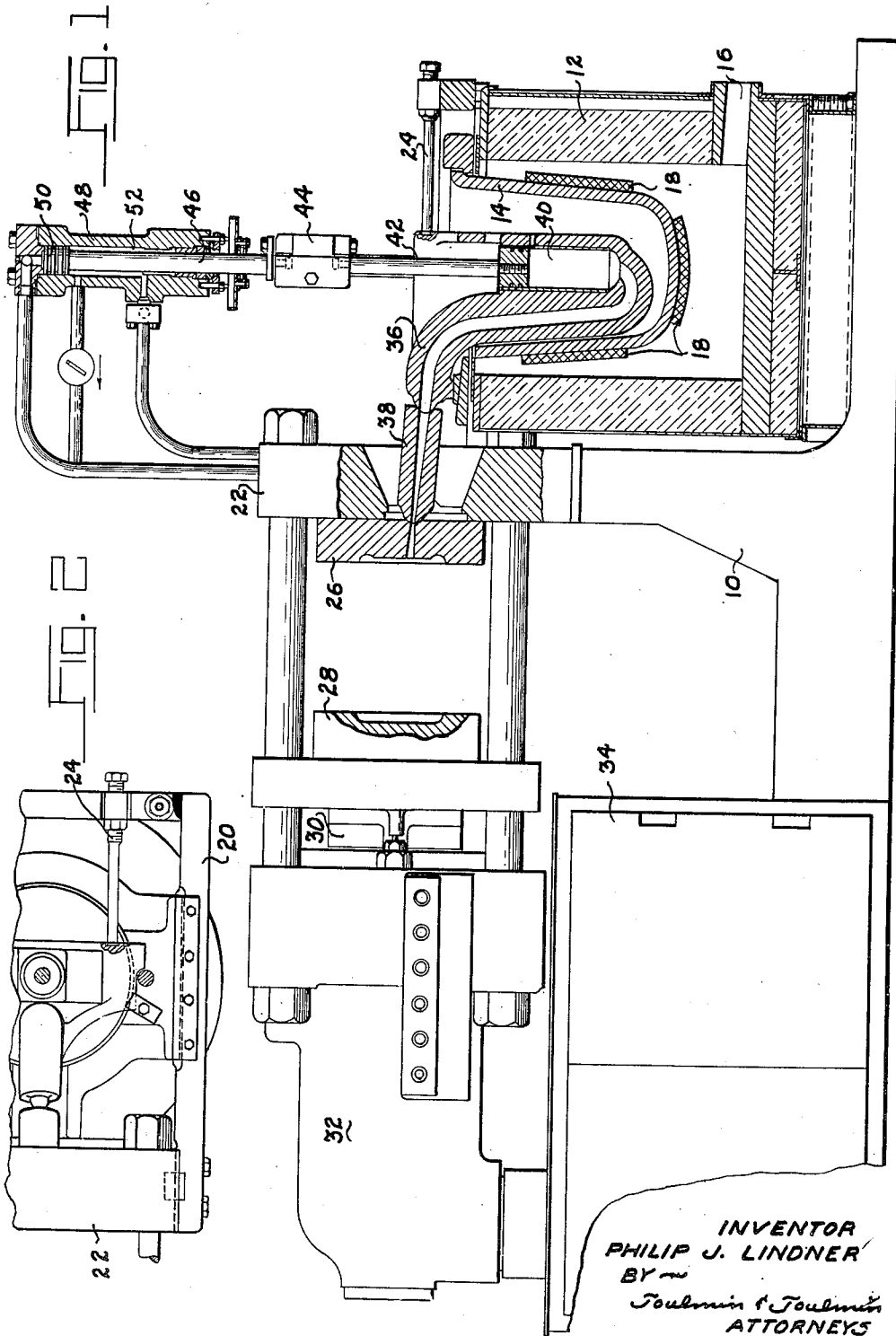
June 19, 1951

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DIE CASTING MACHINE HAVING NONINFLAMMABLE
FLUID-ACTUATED INJECTION PLUNGER

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Filed Oct. 27, 1947

2 Sheets-Sheet 1

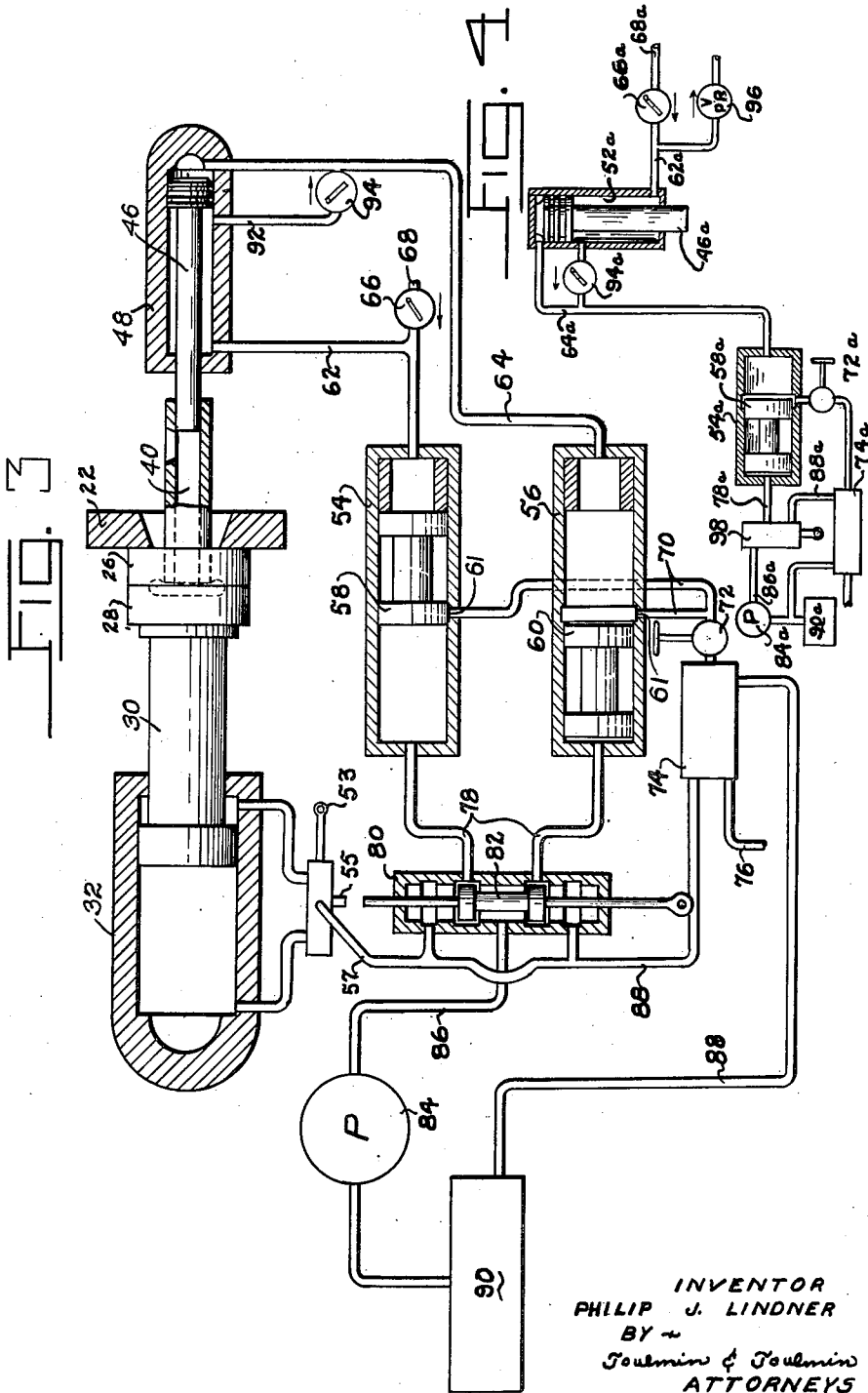


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DIE CASTING MACHINE HAVING NONIN-
FLAMMABLE FLUID-ACTUATED INJECTION PLUNGERPhilip J. Lindner, Mount Gilead, Ohio, assignor
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4 Claims. (Cl. 22—68)

1

This invention relates to die casting machines, and particularly to fluid operable die casting machines.

In die casting machines, especially of the goose neck type, there is a body molten metal of more or less large size which is being conveyed to the die being filled and which, at least during a part of the time, is exposed to the atmosphere.

In the preferred type of machine the injection plunger which conveys the molten material into the die is fluid operated, generally by a hydraulic means such as oil.

Due to the fact that the injection plunger is necessarily closely adjacent the supply of molten metal for the machine, any leakage of the hydraulic actuating fluid from around the plunger, or any leaks from the conduits leading to the plunger, would result in contamination of the metal being cast and the possibility of fire or explosion with the attendant hazard to the operator and to the casting equipment.

This danger is particularly apparent in connection with goose neck type machines wherein the injection plunger generally acts vertically downwardly from immediately above a large crucible which is heated to maintain a quantity of the casting metal in the molten condition.

In this particular instance it is absolutely essential that there be no leakage of oil from around the injection plunger because it would fall directly into the hot crucible.

While the danger of explosion or spattering of the hot metal is present to a certain degree regardless of the type of hydraulic fluid used for operating the injection plunger, this danger may be greatly reduced by employing a non-inflammable fluid, and may be reduced to a minimum by the use of water.

Accordingly, one of the primary objects of this invention is to provide an improved hydraulic operating system for at least the injection plunger of a die casting machine in which the hydraulic medium is water.

Another object is to provide a fluid operable system for the injection plunger of a die casting machine in which the fluid medium is non-inflammable.

Since die casting machines deal with molten metal, temperatures of one thousand degrees Fahrenheit and upward are encountered in the injection chamber and the injection plunger is thus sometimes raised to a relatively high temperature. This causes expansion of the plunger which will promote wear on the packing and bushings through which it moves at the end of

2

the injection motor cylinder, and also has a tendency to cause the plunger to stick in the injection cylinder from which it transfers the molten metal to the die.

This tendency of the injection plunger to expand due to the heat of the metal on which it works is best counteracted by keeping the said plunger at a temperature substantially below that of the molten metal.

Accordingly, it is a still further object of this invention to provide a novel cooling means for the injection plunger of a die casting machine.

It is also an object to employ a water medium for actuating the plunger of a die casting machine and to utilize the said medium for maintaining the injection plunger cool.

Due to the fact that die casting machines generally have associated therewith, either integrally connected or immediately adjacent, a supply of molten metal, the entire machine has a tendency to become heated and to transfer this heat to the fluid medium which actuates the injection ram and the clamping motor.

In most instances the clamping motor is operated by an oil hydraulic system and in this case not only is the oil raised in temperature because of the heat of the machine, but substantial temperature increases occur in the oil due to the work being performed thereby.

In order to maintain the oil cool and promote efficient operation of the pump therefor and the clamping motor driven thereby, it is customary to employ a heat exchanger or oil cooler through which the oil and cooling water are passed. This maintains the oil at the proper temperature but in certain instances requires considerable volume of water.

A still further object of the present invention is to utilize the waste water from the water operated injection end of the machine for cooling the oil employed in the oil hydraulic pressure system for the clamping end of the machine.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a side view of a typical die casting machine adapted for utilizing this invention;

Figure 2 is a partial plan view of the machine shown in Figure 1;

Figure 3 is a diagrammatic operating circuit for the die casting machine; and

Figure 4 shows a somewhat modified arrangement of the operating circuit.

Referring to the drawings, 10 indicates the

press bed and supported adjacent the bed is a heating chamber 12 within which is mounted a crucible 14 for maintaining the molten metal to be cast.

The heating chamber may be supplied with heat by means of a gas flame as through the opening at 16, or heat may be supplied directly to the crucible by electrical heating means as indicated at 18.

The crucible is slidably mounted on the chamber 12 on the side rails 20 and is adjustable toward and away from the bolster 22 of the bed 10 by the adjusting screws 24.

The bolster 22 supports a stationary die part 26 and movable relative to the stationary die part is a movable die part 28 carried on a clamping ram 30 which extends into a clamp cylinder 32 mounted on the left end of the bed 10.

The clamping motor comprising the clamp ram 30 and cylinder 32 is energized by an oil hydraulic system including a pump and suitable valve and reservoir auxiliaries mounted within the cabinet 34 beneath the cylinder 32.

Returning to the injection end of the machine, the crucible 14 includes a goose neck 36 which communicates with the cavity defined by the die parts 26 and 28 through an adapter member 38 which is clamped between the stationary die part 26 and the end of the goose neck by adjusting the screws 24.

The goose neck 36 leads to the bottom of an injection cylinder 40 within which is reciprocable an injection plunger 42. Downward movement of the injection plunger in the cylinder 40 will displace molten metal therefrom into the cavity of the clamped dies.

The injection plunger extends upwardly and is secured through a connector 44 with a fluid operable plunger 46 which reciprocates in a cylinder 48 and which has associated therewith the advancing means 50 and retracting means 52 energizable by pressure fluid for reciprocating the said plunger.

For operating the die casting machine shown in Figures 1 and 2 the hydraulic circuit illustrated in Figure 3 may be employed. In Figure 3 the injection cylinder 40 and the plunger 46 and cylinder 48 are shown in a horizontal position to indicate that this invention is also adaptable for use in connection with what is known as a cold chamber type machine wherein the molten metal is ladled into the injection cylinder through a feed opening.

In Figure 3 the oil pressure system connected with the clamp ram includes a reversing valve 53 which includes a pressure supply line 55 and an exhaust line 57. Any suitable source of pressure can be employed for supplying fluid under pressure to the pressure supply line 55 of the valve and the source may or may not be the same pump which supplies energy for reciprocating the injection plunger of the machine.

The injection plunger, according to this invention, is adapted for being operated by a water hydraulic system which at one time cools the plunger, eliminates the hazard from fire and explosion due to leakage around the plunger, and cools the oil in an auxiliary oil hydraulic system associated with the press.

The water system for the injection plunger includes a pair of cylinders 54 and 56 which have the pistons 58 and 60 therein which divide the said cylinders into opposite end compartments. The right hand compartment of the cylinder 54 is connected through a conduit 62 with the re-

tracting means 52 of the injection plunger, while the right hand compartment of the cylinder 56 is connected by a conduit 64 with the advancing means 50 of the injection plunger.

A supply of water under pressure is admitted to the conduit 62 through a check valve 66 from a water supply conduit 68. Each of the cylinders 54 and 56 have a bypass port 61 intermediate their ends which is uncovered by the piston in the cylinder when the said piston reaches its extreme left hand position as viewed in Fig. 3. These bypass ports are connected together by the conduits 70 and then lead through a throttle valve 72 to a heat exchanger or oil cooler 74 of any suitable construction wherein heat transfer between two separate bodies of liquid may be accomplished. The water leaving the cooler 74 is conveyed by a conduit 76 to a sewer.

The left hand compartment of each of the cylinders 54 and 56 is connected as by conduits 78, with one of the service ports of a four-way reversing valve 80 which includes the movable valve member 82.

Pressure fluid is supplied to the inlet port of the reversing valve from a pump 84 by a conduit 86, and fluid is exhausted from the valve by a conduit 88 which extends through the cooler 74 and to the reservoir 90.

It will be noted that the exhaust line 57 of the reversing valve 53 is also connected with the conduit 88 and hence the exhaust oil from the clamp motor as well as the exhaust from the valve 80 is conveyed through the cooler 74.

It will be apparent that selective movement of the valve member 82 between extreme end positions will connect either one of the conduits 78 with the pressure line 86 and the other thereof with the exhaust line 88, while connecting that in an intermediate position as shown the valve member connects both the conduits 78 and the conduit 86 with the exhaust conduit 88 thereby bypassing the pump delivery through the cooler 74. When the plunger 46 is in its fully retracted position the piston thereof uncovers a conduit 92 which opens through a check valve 94 into the conduit 64. Inasmuch as there is a continuous water pressure on the conduit 62 due to the supply of water through the check valve 66, the uncovering of the conduit 92 permits a discharge of water from the conduit 68 to the check valve 66, conduit 62, the retracting area of the plunger 46, conduit 92, check valve 94, conduit 64, chamber 56, conduit 70, and valve 72 to the cooler 74.

Advancing and retracting movement of the plunger is controlled by the position of the valve member 82. When it is desired to advance the plunger 46 to initiate an injection cycle, the valve member 82 is moved downwardly, as viewed from Fig. 3, to connect the conduit 78 of the cylinder 56 with the output of the pump 84, while simultaneously connecting the conduit 78 of the cylinder 54 with the exhaust conduit 88. Pressure fluid is thus introduced within the left hand compartment of the cylinder 56 to shift the piston 60 rightwardly, which, in turn, transfers water under pressure from the right hand compartment of the cylinder 56 through the conduit 64 and into the advancing area of the cylinder 48 to force the plunger 46 outwardly of the cylinder 48. At the same time, water within the retracting area of the cylinder 48 is exhausted through the conduit 62 and into the right hand compartment of the cylinder 54 to move the piston 58 leftwardly and to uncover the bypass port 61. Retracting movement of the plunger 46 is accomplished by

5

moving the valve member 82 to its upper end position to connect the output of the pump 84 with the conduit 78 of the cylinder 54, while connecting the conduit 78 of the cylinder 56 with exhaust. Thus, fluid pressure from the pump acts upon the left side of the piston 58 to shift the same rightwardly and to thereby forcibly transfer water from the rightward compartment of the cylinder 54 through the conduit 62 and into the retracting area of the cylinder 48.

Thus, it will be seen that the cylinders 54 and 56, in combination with the reversing valve 80, constitute a pressure transfer unit between the pump 84 and the injection cylinder 48, whereby the pressure of hydraulic oil from the pump may be transferred to the water or other non-inflammable liquid supplied through the conduit 68 to actuate the plunger 46.

It will also be apparent that at one time the supply of water from the conduit 68 thus operates to cool the injection plunger and to supply coolant to the cooling chamber 74 for cooling the oil supply for the pump 84.

In Figure 4 there is shown an arrangement similar to that in Figure 3 and wherein parts corresponding to those of Figure 3 are correspondingly numbered with the addition of a subscript "a." The principal difference in the arrangement of Figure 4 is that the retracting means 52a of the plunger 46a is continuously under water pressure and the advancing movement of the said plunger is accomplished by displacing the water from the retracting means through the relief valve 96.

Inasmuch as there is a continuous pressure supply to the retracting means of the injection plunger, there is only one cylinder as indicated at 54a for transferring the pressure output of the pump 84a to the water system and for forcing water under pressure to the injection plunger. This cylinder 54a has its left hand chamber connected through the conduit 78a with one service port of a three-way valve 98 which has its other service port connected by the exhaust conduit 88a with the cooler 74a.

By the circuit shown in Figure 4, whenever the available water pressure is sufficient to retract the injection plunger, the operating circuit for the said plunger can be simplified by the elimination of one of the water displacement cylinders.

In both of the modifications of Figures 3 and 4 it will be evident that the throttle valve 72, 72a serves to regulate the rate of the bypassing of fluid through the cooler in order to obtain economy of water use, and also serves to maintain a pressure in the bypassing system which prevents air pockets and voids from forming in the oil compartments of the cylinders 54 and 56 and in the cylinder 48 for the plunger 46.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a die casting machine for molten materials; a plurality of relatively engageable dies; a hydraulic motor for moving said dies into and out of engagement and having an exhaust means; a fluid-pressure-operable injection motor for forcibly injecting molten material between said dies, said injection motor having a retracting chamber and an advancing chamber; a source of non-inflammable liquid connected with the re-

6

tracting chamber of said injection motor; a pump; a pressure transfer unit having a connection with the advancing chamber of said injection motor, said source of non-inflammable liquid and said pump, and operable to forcibly inject non-inflammable liquid from said source within the advancing chamber of said injection motor in accordance with the pressure output of said pump; a heat exchanger connected with the exhausting means of said hydraulic motor to receive hydraulic fluid exhausted therefrom; and conduit means connected between said pressure transfer unit and extending through said heat exchanger for conducting non-inflammable liquid from said source through said heat exchanger.

2. In a die casting machine for molten materials; a plurality of relatively engageable dies; a hydraulic motor for moving said dies into and out of engagement and having an exhausting means; a fluid-pressure-operable injection means for forcibly injecting molten material between said dies, said injection means having a retracting chamber and an advancing chamber; a source of non-inflammable liquid directly connected with the retracting chamber of said injection means; a hydraulic pump; a pressure transfer unit having a connection with the advancing chamber of said injection means and with said source of non-inflammable liquid; valve means connected between said hydraulic pump and said pressure transfer unit and operable to introduce hydraulic fluid from said pump to said pressure transfer unit, said pressure transfer unit being operable in response to the introduction of hydraulic fluid therein to forcibly inject non-inflammable liquid from said source within the advancing chamber of said injection means; a heat exchanger connected with the exhausting means of said hydraulic motor and said valve means to receive hydraulic fluid exhausted from said hydraulic motor and said valve means; and conduit means connected with said pressure transfer unit and extending through said heat exchanger for conducting non-inflammable liquid from said transfer unit through said heat exchanger.

3. In a die casting machine; a plurality of relatively engageable dies; fluid-pressure-responsive means for moving said dies into and out of engagement and having an exhausting means; a heat exchanger connected with said exhausting means for receiving fluids exhausted from said fluid-pressure-responsive means; a reciprocating injection plunger having fluid-pressure-responsive advancing and retracting areas and operable to forcibly inject molten material between said dies; a source of non-inflammable liquid connected with the retracting area of said injection plunger; a hydraulic pump; a first pressure transfer means connected to receive the output of said pump and having a connection with the retracting area of said plunger and with said source and operable in response to fluid pressure from said pump to forcibly inject non-inflammable liquid against the retracting area of said plunger; a second pressure transfer means connected to receive the output of said pump and having connection with said first pressure transfer means and with the advancing area of said plunger and operable in response to fluid pressure from said pump to forcibly inject non-inflammable liquid against the advancing area of said plunger; and conduit means connected with each of said pressure transfer means and extend-

7

ing through said heat exchanger for conducting non-inflammable liquids from said pressure transfer means through said heat exchanger.

4. In a die casting machine for molten materials; a pair of relatively engageable dies; a differential hydraulic ram for moving said dies into and out of engagement; valve means for exhausting fluid from said ram; a fluid-operable injection ram having an advancing chamber and a retracting chamber and operable upon advancing movement to forcibly inject molten materials between said dies; a source of pressurized non-inflammable liquid directly connected with the retracting chamber of said injection ram; pressure transfer means having a discharge outlet connected with the advancing chamber of said injection ram and also communicating with the retracting chamber of said injection ram when the latter occupies its fully retracted position, a pump for supplying pressure fluid to said pressure transfer means, said pressure transfer means being operable in response to pressure fluid from

8

said pump to forcibly inject non-inflammable liquid received from the retracting chamber of said injection ram into the advancing chamber thereof; a heat exchanger connected with said valve means to receive fluid exhausted from said differential ram; and conduit means extending from said pressure transfer means to said heat exchanger for conducting non-inflammable liquid received in said pressure transfer means to said heat exchanger.

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