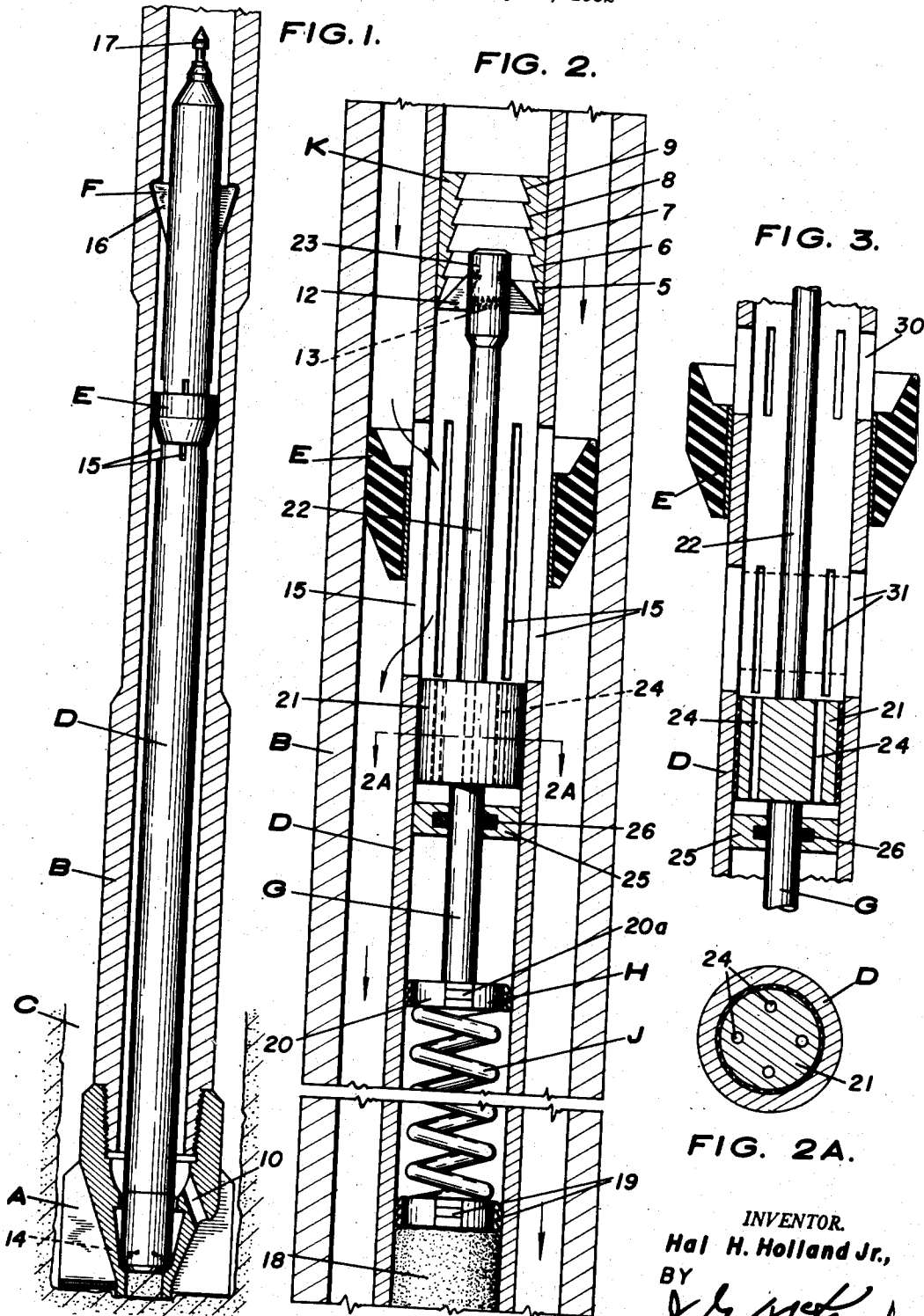


Sept. 15, 1953

H. H. HOLLAND, JR
CORE RECOVERY INDICATING DEVICE

2,652,232

Filed July 14, 1952



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UNITED STATES PATENT OFFICE

2,652,232

CORE RECOVERY INDICATING DEVICE

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Application July 14, 1952, Serial No. 298,781

8 Claims. (Cl. 255-72)

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This application is directed to a core barrel for a rotary drilling rig whereby indications are received at the surface during the coring operation which indicate whether a core is being recovered.

Other objections and advantages of the present invention will be seen from the following detailed description taken in conjunction with the drawing which:

Fig. 1 is an elevation, partly in section, showing an embodiment of the core barrel in position in the drill stem for receiving a core;

Fig. 2 is an enlarged fragmentary view, partly in section, showing further details of construction of the embodiment of Fig. 1;

Fig. 2A is a view in section taken along the line 2A-2A of Fig. 2; and,

Fig. 3 is an enlarged fragmentary view similar to Fig. 2 showing another embodiment of the present invention.

Turning now specifically to the drawing and first to Fig. 1, a conventional drill bit A mounted in the lower end of drill stem B is shown in position for cutting a core at the bottom of a borehole C.

The principal parts of the core barrel shown are an elongated annular barrel D with a packer E mounted thereon with a releasable latch F for latching it to the drill stem. Within the barrel D, as seen in Fig. 2, is a plunger assembly G, a circular plate H which fits loosely within the barrel and adapted to be moved upwardly as the core enters the barrel and a spring J between plate H and plunger assembly G. The upper portion of barrel D has mounted on its interior a vertically arranged series of stops K designated 5, 6, 7, 8, and 9 of progressively decreasing diameter in the upward direction.

Cooperating with series of stops K are dogs 12 which are biased outwardly by spring 13. Dogs 12 and spring 13 form parts of plunger assembly G.

Core barrel D may be of the usual dimensions of a core barrel and provided with a conventional core catcher 14 at its lower end to retain the core cut by bit A which enters into the central passage of barrel D. The upper end of the barrel is provided with latch assembly F for latching the barrel to the drill stem. In the drawing the parts of latch assembly F shown are dogs 16 and retrievable spear head member 17. Since such latches are well known to the art, further details of construction have been omitted in order to simplify the description. Some distance below latch assembly F, barrel D is provided with a plurality of spaced longitudinally extending slots 15.

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Within the barrel D is mounted the circular plate H which is pushed upwardly as core 18 enters the barrel. It is desirable to provide plate H with slips 19 so that once the plate has been pushed upwardly by the core there is no additional force exerted on it by spring J unless additional core is cut and enters the barrel. The plunger assembly G consists of a lower plate 20, a piston 21 which is slidable within core barrel D and has imperforate walls at the lower end of which plate 20 is mounted and which passes through and has piston 21 secured thereto and has its upper end terminating in a head 23 to which dogs 12 are pivotally mounted and providing a suitable recess into which spring 13 is arranged to bias dogs 12 outwardly into contact with graduated stops K. Plate 20 is also provided with slips 20a so as to allow only upward movement of assembly G.

Piston 21 of plunger assembly G is provided with passages 24 extending from its upper surface to its lower surface to assist in the pressure equalization between the two surfaces thereof. Core barrel body D is provided with a partition 25 having a central passage with packing ring 26 which embraces and packs off rod 22 of assembly G at a point between piston 21 and lower plate 20. Partition 25, in effect, divides core barrel D into an upper chamber and a lower chamber and prevents the pump fluid, which may pass through passages 24 of piston 21, from entering into the lower chamber which is adapted to receive the core.

Piston 21 and longitudinally extending slots 15 of barrel D cooperate to form a type of slide valve. When piston 21 is in a first position (its lower position as shown in the drawing) fluid above packer E may pass from the annulus between drill collar B and barrel D through the ports of slots 15 above packer E into barrel D and then from barrel D through the parts of slots 15 below packer E back into the annulus between barrel D and drill collar B where it may continue its flow downwardly. Piston 21 is movable from its first position to a second position (its uppermost position in the embodiments shown in the drawing) where it greatly reduces the effective area of flow of slots 15. It will be understood that the piston 21 may move from its first position to its second position in a stepwise fashion, with at least some of said steps of the series progressively decreasing the area of flow. In the embodiment shown where a cup-type packer E is used to divert the flow from the annulus between the drill collar and the core barrel into

3 the slots, it is desirable to provide a fluid passage from the part of the annulus above packer E to that part below packer E to facilitate the withdrawal of the core barrel assembly. In the embodiment of Figs. 1 and 2 there is such a passage inasmuch as the packer E is mounted on the exterior of the barrel and piston 21 makes contact with the interior of the barrel, thus the thickness of the wall of barrel D allows slots 15 to serve as passages even if the upper end of plunger 21 is at the same level as packer E. When piston 21 is raised so that its lower end is past the lower end of slots 15 an increased flow area is provided by passageways 24 of piston 21 as will later be explained.

The two springs J and 13 are proportioned so that a change in the effective length of J is sufficient to cause a predetermined change in the effective length of 13. Thus, as spring J is compressed by core 13 entering the barrel, the plunger assembly G moves upwardly compressing spring 13 and causing the dogs 12 to move in turn past the stops 11.

In using the device of the present invention it may either be dropped down the drill stem and then retrieved with a sand line after a core has been cut or alternatively may be lowered on the end of a sand line. In any event, it assumes the position shown in Fig. 1 when in core cutting position. The interior mechanism is initially arranged with plunger assembly G in a lower position with dogs 11 in contact with the lowermost stop of the graduated stops 12. The interior of the barrel is, of course, free from a core so that circular plate H is in its lowermost position and spring J is in its extended position. In the position of plunger assembly G described, the upper wall of piston 21 is below the lower ends of longitudinal slots 15.

In cutting the core, the drill stem is rotated and drilling fluid is pumped downwardly through the drill stem in the usual manner. When the drilling fluid reaches the point in the drill collar where the core barrel assembly is arranged, it flows in the annular space between the outer wall of barrel D and the inner wall of drill stem B until it reaches packer E where it is forced to flow through slots 15 into barrel D, then downwardly in the flow passage between the wall of barrel D and rod 22, then outwardly through the lower portion of slots 15 and downwardly in the annular space between the outer wall of barrel D and inner surface of drill stem B and then through the mud courses 16 of the drill bit. The mud then flows upwardly in the usual manner between the outer wall of drill stem D and the wall of borehole C.

As core 13 is cut it necessarily forces circular plate H upwardly in order to enter the core barrel. This upward movement of plate H in turn causes spring J to compress. Since springs J and spring 13 are selected to have a predetermined relationship, the compression of spring J a certain initial amount causes such a force to be exerted through plunger assembly G as to compress spring 13 and move it past stop 5, which is the lowermost series of stops K. Upon movement of plunger assembly G, piston 21 of the assembly is forced upwardly until its upper end is above the lower portion of longitudinal slot 15 thus reducing the amount of flow area for the drilling fluid and causing an indication at the surface by an increase of pump pressure in the mud pumps. As additional core enters the barrel D, plate H is forced upwardly an additional

amount, in turn additionally compressing spring J and when this compression exceeds a predetermined amount the dogs 12 are pushed past stop 6, the second stop of the series of stops K, piston 21 moving upwardly and further reducing the flow area of slots 15 and causing another increase of pump pressure.

The device as shown is proportioned such that as dogs 12 move upwardly against stop members 5, 6, and 7 piston 21 progressively reduces the flow area of slots 15 thus causing three stepwise increases in mud pressure. However, in the embodiment shown, when the dogs 12 reach this position, the upper end of piston 21 has moved up even with the lower end of packer E so that the pump pressure remains substantially constant while dogs 12 move along stop member 8. Further upward movement of piston 21 (at which time dogs 12 are in contact with stop 9) causes the lower end of piston 21 to rise above the lower end of slot 15 and fluid may flow through passages 24 of the piston and out through the exposed lower portions of slot 15 which will cause a reduction in pump pressure. Summarizing, the five stepwise movements along stops 5, 6, 7, 8, and 9 result in three stepwise increases in pump pressure, then a step where the pump pressure remains constant and a final step where the pump pressure decreases. When the pump pressure decreases or drops suddenly (the final step) this is an indication to the operator that the desired amount of core is in the core barrel. At this point the lower end of piston 21 is above the lower ends of slots 15, thus affording a bypass for the flow of mud around cup packer E which allows the entire assembly to be easily withdrawn.

It will be understood that if difficulty is encountered during the coring operations so that core is not entering the barrel, the stepwise increases in mud pump pressure will not occur, and this will indicate to the drilling crew that some correction of the coring operation should be made. Thus, the device of the present invention enables a signal to be transmitted to the drilling crew at the surface at the time a core is being cut in the borehole so that it is unnecessary to withdraw the core barrel in order to determine whether or not the attempt to take the core is successful.

When the core barrel is to be removed from the drill stem, as when a core has been cut, it may be removed in the usual manner with a sand line.

As a further embodiment of the present invention, instead of a single series of longitudinal slots 15, two series of longitudinal slots, an upper series and a lower series, may be used. Such an embodiment is shown in a fragmentary view in Fig. 3. In Fig. 3 barrel D is provided with an upper series of longitudinal slots 30 arranged above packer E and a lower series of longitudinal slots 31 below packer E. This embodiment will operate in exactly the same way as in the embodiment of Figs. 1 and 2 except that bypass passages are not provided adjacent cup packer E for flow of fluid.

From the description of the present invention, it will be seen that I have provided a retrievable core barrel having a construction which causes stepwise changes in pressure in the mud pump as a core enters the core barrel during the cutting of a core. Thus, the crew is provided with a signal which indicates the success of the coring operation.

While I have disclosed specific embodiments of

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the present invention, it will be obvious to a workman skilled in the art that various changes in the sizes, shapes and proportions of the parts may be made without departing from the scope of the invention.

What I desire to claim is:

1. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having a partition to divide it into a lower compartment fluidly sealed from an upper compartment and having at least one longitudinally extending slot in its wall above said partition, releasable latching means mounted on said barrel for latching it to said drill stem, a packing member mounted on said barrel in such a way that at least a portion of said longitudinally extending slot is exposed below said packing member, a longitudinally movable slide valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the slot area below the packing member is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel in the lower compartment adapted to be pushed upwardly as the core enters said barrel and a linkage mechanically connecting said contacting member with said slide valve member for causing said slide valve member to move from its first position to its second position upon longitudinal movement of said contacting member.

2. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for passage of drilling mud, said barrel having a partition pierced by a passage to divide it into a lower compartment and an upper compartment and having at least one longitudinally extending slot in its wall above said partition, a packing member mounted on said barrel in such a way that at least a portion of said longitudinally extending slot is exposed below said packing member, a longitudinally movable slide valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the slot area below the packing member is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel adapted to be pushed upwardly as the core enters said barrel, a rod passing through said partition and mechanically linking said contacting member with said slide valve member for causing said slide valve member to move from its first position to its second position upon longitudinal movement of said contacting member and a sealing means carried by the partition fluidly sealing around said rod member to seal the upper compartment from the lower compartment.

3. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having a partition pierced by a cen-

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tral passage to divide it into a lower compartment and an upper compartment and having a plurality of circumferentially spaced longitudinally extending slots in its wall above said partition, packing member mounted on said barrel in such a way that at least a portion of each of said longitudinally extending slots is exposed below said packing member, a longitudinally movable cylindrical slide member with passages fluidly connecting its upper face with its lower face mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the slot area of each of said slots below the packing member is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel adapted to be pushed upwardly as the core enters the barrel, a rod passing through the central passage of said partition and mechanically linking said contacting member with said slide valve member for causing said slide valve member to move from its first position to its second position upon longitudinal movement of said contacting member and a sealing means carried by said partition sealing around said rod member to seal fluidly the upper compartment from the lower compartment.

4. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having a partition to divide it into a lower compartment fluidly sealed from said upper compartment, at least one longitudinally extending slot in its wall above said partition and a longitudinally arranged series of stops of progressively differing diameter carried by the inner wall of said barrel, releasable latching means mounted on said barrel for latching it to said drill stem, a packing member mounted on said barrel in such a way that at least a portion of said longitudinally extending slot is exposed below said packing member, a longitudinally movable slide valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the slot area below the packer is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel in the lower compartment adapted to be pushed upwardly as the core enters said barrel, a linkage mechanically connecting said contacting member with said slide valve member for causing said slide valve member to move from its first position to its second position upon longitudinal movement of said contacting member and carrying dogs arranged to make contact with said series of stops and a spring member operatively arranged to bias said dogs into contact with said stops.

5. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in a drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having a partition to divide it into a lower compartment fluidly sealed from an upper compartment, at least one longitudinally extending slot in its wall above said partition and a longitudinally arranged series of stops of pro-

gressively differing diameter carried by the inner wall of said barrel, releasable latching means mounted on said barrel for latching it to said drill stem, a packing member mounted on said barrel in such a way that at least a portion of said longitudinally extending slot is exposed below said packing member, a longitudinally movable slide valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the area of the slots below the packing member is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel in the lower compartment adapted to be pushed upwardly as the core enters said barrel, a linkage mechanically connecting said contacting member with said slide valve for causing said slide valve member to move from its first position to its second position upon longitudinal movement of said contacting member and carrying dogs arranged to make contact with said series of stops, a first spring member operatively arranged to bias said dogs in contact with said stops and a second spring member operatively arranged between said contacting member and said plunger member, said first and second spring members bearing such a relationship that a predetermined change in the effective length of said second spring member causes a predetermined change in the effective length of the first spring member whereby a progressive upward movement of said contacting member causes a predetermined and smaller longitudinal movement of said plunger assembly.

6. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having a partition pierced by a central passage to divide it into a lower compartment and an upper compartment and having a plurality of circumferentially spaced longitudinally extending slots in its wall above said partition and a longitudinally arranged series of stops of progressively differing diameter carried by the inner wall of said barrel, releasable latching means mounted on said barrel for latching it to the drill stem, a packing member mounted on said barrel in such a way that at least a portion of each of said longitudinally extending slots are exposed below said packing member, a contacting member slidably fitting in the lower end of said barrel in the lower compartment adapted to be pushed upwardly as the core enters said barrel, a plunger assembly mounted in said barrel for slidable longitudinal movement including a cylindrical slide valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of the area of each of the slots below the packing member is covered than in said first position, and a rod passing through the central opening of the partition and extending into said lower compartment and having dogs mounted thereon arranged to make contact with said series of stops, a sealing member carried by the partition making a fluid-tight seal with said rod portion of the plunger assembly for sealing the lower compartment fluidly

from the upper compartment, a first spring member operatively arranged to bias said dogs into contact with said stops, a second spring member operatively arranged between said contacting member and said plunger assembly, said first and second spring members bearing such a relationship that a predetermined change in the effective length of the second spring member causes a predetermined change in the effective length of the first spring member whereby a progressive upward movement of said contacting member causes a predetermined and smaller longitudinal movement of said plunger assembly.

7. A core barrel for use in a drill stem adjacent a drill bit comprising, in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for the passage of drilling mud, said barrel having at least one longitudinally extending slot in its wall and a longitudinally arranged series of stops of progressively differing diameter carried by the inner wall of said barrel, releasable latching means mounted on said barrel for latching it to said drill stem, a packing member mounted on the slotted portion of said barrel for making contact with the inner wall of said drill stem and of such dimensions that at least a portion of a longitudinally extending slot extends above and at least a portion of a longitudinally extending slot extends below said packing member, a contacting member slidably fitting in the lower end of said barrel adapted to be pushed upwardly as the core enters said barrel, a plunger assembly mounted in said barrel and including a valve member having a cylindrical imperforate wall in slidable sealing contact with the inner wall of said barrel and arranged to be moved longitudinally from a first position to a second position in which more of said slot area is covered than in said first position, said plunger assembly having dogs arranged to make contact with said series of stops, a first spring member operatively arranged to bias said dogs into contact with said stops, a second spring member operatively arranged between said contacting member and said plunger member, said first and second spring members bearing such a relationship that a predetermined change in the effective length of the second spring member causes a predetermined change in the effective length of the first spring member whereby a progressive upward movement of said contacting member causes a predetermined and smaller longitudinal movement of said plunger assembly.

8. A core barrel for use in a drill stem adjacent a drill bit, comprising in combination, an elongated tubular barrel adapted to fit loosely in the drill stem with clearance between the outer surface of the barrel and the inner surface of the drill stem for passage of drilling mud, said barrel having a partition pierced by a passage to divide it into a lower compartment and an upper compartment and having at least one opening in its side wall above said partition, a packing member mounted on said barrel in such a way that at least a portion of said opening in the side wall is exposed below said packing member, a movable valve member mounted in the upper compartment in slidable sealing contact with the inner wall of said barrel and arranged to be moved from a first position to a

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second position in which more of the area of said opening in the side wall below the packing member is covered than in said first position, a contacting member slidably fitting in the lower end of said barrel in the lower compartment adapted to be pushed upwardly as the core enters said barrel and a linkage mechanically connecting said contacting member with said slide valve member for causing said slide valve member to move from its first position to its second

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position upon longitudinal movement of said contacting member.

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