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WELL SCREEN STRUCTURE

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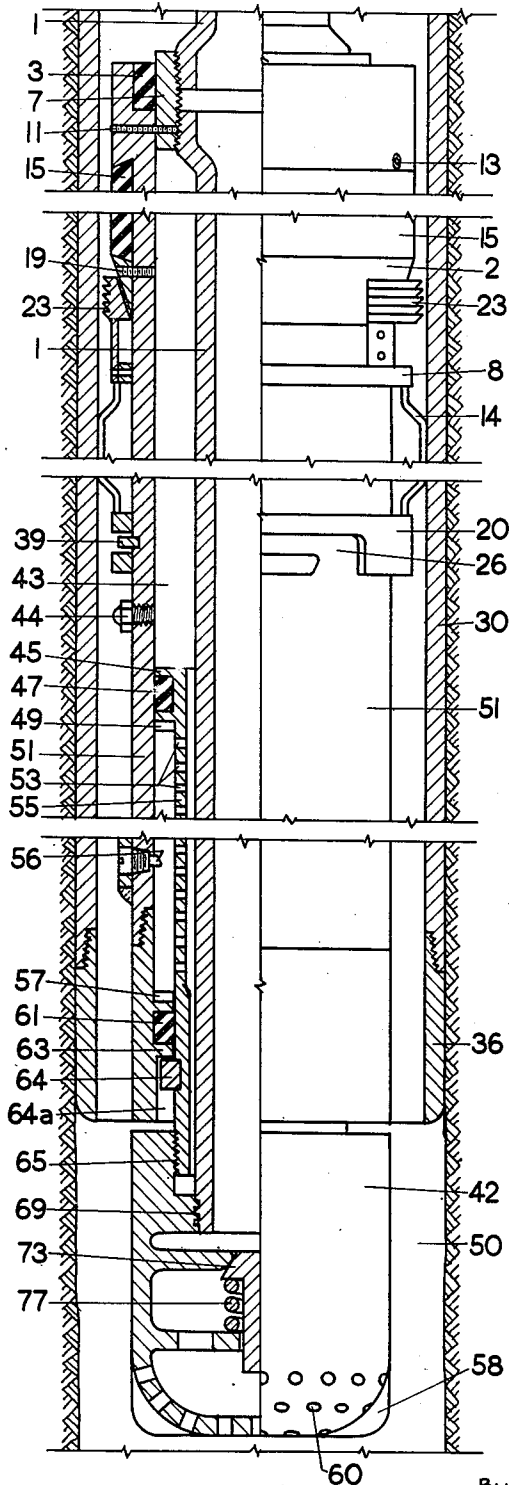


Fig. 1

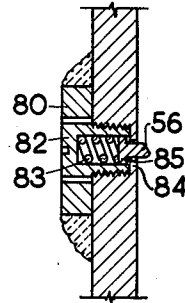
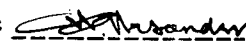


Fig. 2

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## UNITED STATES PATENT OFFICE

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## WELL SCREEN STRUCTURE

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6 Claims. (Cl. 166—20)

This invention pertains to screens used in oil and gas wells, and relates more particularly to a housing structure adapted to enclose and to protect a screen while being lowered into a well and installed therein.

It has heretofore been customary to run screens into wells at the end of a tubing or drill pipe string, thus leaving the screen in an exposed or unprotected condition during the lowering and washing operations.

The majority of screen failures result from erosion, which is either directly caused, or largely aggravated, by the impregnation of the screen with drilling fluid and other substances and debris present in the well when the screen is being run therein. A large proportion of this clogging mud and debris cannot be washed out of the screen while being set, or when in place, unless complicated, dangerous and expensive washing operations are undertaken. The operating efficiency and capacity of clogged screens is naturally greatly reduced.

Screens, especially those of the wire-wrapped type, are furthermore often damaged by contact with pieces of fragments of metal or other material attached to the casing and projecting into the well from the inner wall thereof.

It is therefore an object of this invention to eliminate or minimize possible injury or impairment to screens by providing a screen structure comprising a protective housing adapted to enclose the screen during the lowering and washing operations.

It is also an object of this invention to provide a screen structure comprising a tubing string, a screen attached thereto, and a housing slidably enclosing the screen, said housing being provided with a packing device adapted to be set or anchored in a well, whereby the screen may be forced out of the housing by applying a downward force to the tubing string after the housing has been anchored in the well.

It is also an object of this invention to provide a screen structure wherein the screen is housed during lowering operations in a chamber filled with a protective or anti-corrosive material or liquid, whereby said screen is maintained out of direct contact with the well fluid during the lowering and washing operations.

These, and other objects of the present invention will be understood from the following description taken with reference to the attached drawing wherein:

Fig. 1 is a diagrammatic view, partly in cross-section, of the present screen structure.

Fig. 2 is a detailed view of the latch 56 of Fig. 1.

Fig. 1 represents diagrammatically a well 50 provided to a desired level with a casing 30 having a shoe 36. The present screen structure is shown in the well in its retracted position, that is, in the position in which it is lowered into the well. A tubing string comprising any desired number of tubing sections 1, joined together by means of couplings 7, is detachably connected at its lower end to a shoe 42, preferably by means of left-hand screw-threads 69. The shoe 42 is preferably of the non-return type, and comprises perforations 60, and a valve 73 held against its seat by means of a spring 77, so that fluid may be circulated into the well through the tubing 1 for washing purposes, but cannot enter said tubing from the well. Instead of the valve 73, the shoe may be provided with any other suitable non-return valve, such as a ball valve, or with duplicate valves to insure closing after the washing operation. The shoe is also provided on the outside with blades 58, which may serve to clear away obstructions which may be encountered while lowering the device into the well.

Attached to the shoe 42 by means such, for example, as right-hand screw-threads 65, and surrounding the lower portion of the tubing string 1, is a tubular screen 55, shown for simplicity as provided with apertures or perforations 53, it being understood that any other type of screen, such as screen comprising a wrapping of wire wound on a tubular member or frame, is suitable for the present invention.

The tubular screen 55 has in its upper portion an outwardly enlarged annular shoulder member 45, provided with a clutch or key member 49, adapted to engage a similar clutch or keyway member 57, as will be explained hereinbelow. The shoulder 45 is likewise provided with an annular gland or packing member 47.

Slidably surrounding the screen 55 is a tubular housing member 51, held in fixed relationship with regard to the string 1 by any suitable locking means, such, for example, as a frangible pin 11, made of brass, bronze, copper or other metal or material. The pin 11 is shown as connecting the housing 51 with the coupling 7 of the tubing string, although it is obvious that the same result is achieved by connecting the housing 51 directly to the tubing 1, or to any member forming a rigid structure therewith such for example, as the shoulder 45 of screen 55, as long as, when unlocked, as by the shearing of frangible pin 11, the tubing screen assembly can slide downwards within housing 51.

The housing 51 has in its lower portion an inwardly enlarged annular shoulder member 63, provided with an annular gland or packing member 61, having a fluid-tight fit about the screen 55, and with a clutch or keyway member 57. Upon a sliding downward motion of the screen 55 with regard to the housing 51, the screen shoulder 45 comes to rest on the housing shoulder 63, and the key or clutch members 49 and 57 engage each other to prevent any rotational motion of the screen with regard to the housing 51.

As shown in greater detail in Figure 2, the housing 51 is also equipped with one or more latches 56, which are forced by springs 83 against the screen 55 through suitably provided openings in the housing 51. Hollow plugs 82 are provided for mounting the springs 83, which force the square-cross section latches against the screen, until the shoulder 85 of the latch and the shoulder 84 of the housing come into contact with each other. A shield 80 is welded in a streamlined manner to the outside of the housing 51 to protect the latches while running the device into the well. The purpose of latches 56 is to permit the enlarged annular shoulder member 45 to pass the latches in a downward direction but not in an upward direction. Thus, when tubing 1 is released from shoe 42, as will be explained below, the well pressure will not be able to force the screen back into the housing.

A key element 64, or an equivalent clutch or friction member, is fixedly attached to the screen 55, while a corresponding keyway or clutch element 64a is provided in the housing 51 to prevent rotation of the screen and housing when the screen is in its uppermost position, whereby light obstructions or debris encountered while lowering the device into the well may be cleared away by the blades 58, upon rotating the string, without imposing a shearing stress on the pin 11.

The housing 51 has also in its upper portion an annular gland or packing member 3, having a fluid tight fit about the tubing string 1. Annular glands 3 and 61 thus provide sealing means for an annular chamber 43 formed between the housing 51 and the tubing string 1, which chamber serves to enclose the screen 55. A port closed by a plug 44 is used to fill said chamber with a light grease, lubricating oil or other suitable protective and non-corrosive substance, which is forced into chamber 43 until the chamber is full so as to prevent any well fluid from leaking into the chamber 43 during the lowering operation.

This port may be installed at the lower end to enable the pumping of viscous fluids such as grease into the housing, as shown in the drawing, or may be installed at the upper end of the chamber immediately below pin 11 to facilitate pouring liquid into the housing. An equalizing vent 13 in the housing may be incorporated at the upper end of the housing to permit of equalization of pressure within and without the housing while lowering into the well. This vent would permit equalization of pressure with negligible mixing of the fluids within and without the housing.

Carried outwardly on the housing 51 is a packer member 15, of any desired and suitable type, which is held in place by a slip bowl 2, slidably surrounding the housing and held in place by shear pin 19.

Slidably fitting over the tapered outward face of the slip bowl 2 are slips 23, adapted to engage the casing 30 upon upward motion. The slips are held in place by means of a ring 8, slidably fit-

ting over the housing and connected by means of guide or friction springs 14 with a slidable locking or latch ring 20 having a notch 26 adapted to receive a pin or pins 39, fixedly attached to the housing.

It is obvious that instead of the packer and slips arrangement described above and shown in the drawing, any other suitable conventional packer and slip means may be used to achieve the desired purpose, as will be shown below.

The operation of the present device is as follows:

The screen structure or assembly is run into the well at the end of a tubing or drill string 1. When the casing shoe 36 or other desired position above the setting point is reached, washing is commenced by pumping a clean fluid down through the tubing 1, the fluid pressure forcing the valve 73 down, and the fluid returning to the surface through the annular space between the screen structure or the tubing and the walls of the well or casing.

The well is washed to the final bottom screen position until the formation can be considered clean or until the well shows a tendency to flow. The assembly is then raised to such a position that the packer 15 is slightly above its desired final position, for example, a position slightly above that shown in the drawing. The tubing 1 is then rotated, and the friction of the springs 14 against the casing preventing the latch ring 20 from following this rotation, the latch ring is released from engagement with the pin 39. The assembly is then slightly lowered, the rings 20 and 8 and the slips 23 being still prevented to follow this downward motion due to the frictional engagement of the springs 14 with the casing. This causes the slips 23 to slide over the tapered face of the slip bowl 2 and to engage the casing. A downward pressure on the tubing causes the pin 11 which, by design, has a lower strength than pin 19, to shear. While continuing to wash by pumping, the tubing 1, shoe 42, and screen 55 are then lowered until the whole apertured space of the screen is exposed to the bore-hole, and the clutches 49 and 57 of the screen and housing respectively are in engagement with each other.

At this time, the screen is at its fully extended position, is locked against rotation by clutches 49 and 57, and is prevented from being forced upwards by well or other pressure by latches 56. The wash pump at the surface is then shut down, and additional weight on tubing 1, applied to shoe 42, is transmitted, by tension, through screen 55, the contacting upper and lower shoulders of 45 and 63, and the housing 51, to pin 19. This will shear pin 19 and thus cause the housing to slide through bowl 2, which is held from downward movement by slips 23, thus expanding the packing 15 against the casing 30 and sealing off the flow in the annular space between casing 30 and housing 51.

Clockwise rotation is then applied to the tubing 1, and the lefthand screw joint 69 is thus broken, since the shoe 42 and screen 55 are prevented from rotating due to engagement, through clutch members 49-57, with the rigidly anchored housing 51. After the tubing 1 has been unscrewed at 69 from the shoe, it may be raised to any desired level, or entirely removed from the well, production of the well being effected through the screen, inside of housing 51, and tubing 1 or the casing 30 above the expanded packer 15.

We claim as our invention:

1. A well structure comprising a tubular string

adapted to be lowered into a well, a tubular screen surrounding the lower portion of said string, said string and screen being detachably connected to each other, a tubular housing slidably surrounding the screen, said housing and string forming an annular chamber enclosing said screen, locking means securing said housing with regard to the string, and anchoring means mounted on the housing for setting said housing in a well.

2. A well screen structure comprising a tubular string adapted to be lowered into a well, a shoe detachably affixed to the lower end of said string, a tubular screen affixed to said shoe and extending thereabove around said string, a tubular housing slidably surrounding said screen, said housing and string forming an annular chamber for said screen, frangible means locking said housing with regard to the string, and anchoring means outwardly mounted on the housing for setting said housing within a well.

3. A well screen structure comprising a tubular string adapted to be lowered into a well, a shoe detachably affixed to the lower end of said string, a tubular screen affixed to said shoe and extending thereabove around said string, a tubular housing slidably surrounding said screen, said housing and string forming an annular chamber for said screen, annular packing members adapted to seal said chamber in fluid-tight manner, frangible means locking said housing with regard to the string, and anchoring means outwardly mounted on the housing for setting said housing within a well.

4. A well screen structure comprising a tubular string adapted to be lowered into a well, a shoe detachably affixed to the lower end of said string, a tubular screen affixed to said shoe and extending thereabove around said string, a tubular housing slidably surrounding said screen, said housing and string forming an annular chamber for said screen, annular packing members adapted to seal said chamber, normally closed port means in said housing for introducing a viscous non-corrosive material into said chamber, frangible means locking said housing with regard to the string, and anchoring means outwardly mounted on the housing for setting said housing within a well.

5. A well screen structure comprising a tubular string adapted to be lowered into a well, a shoe detachably carried at the lower end of said

string, a tubular screen affixed to said shoe and extending thereabove around said string, a tubular housing slidably surrounding said screen, said housing and string forming an annular chamber for said screen, annular packing members adapted to seal said chamber, frangible means locking said housing with regard to the string, packer means comprising anchoring slips outwardly mounted on said housing for setting said housing in a well, whereby said string, screen and shoe can be lowered with regard to the housing by applying to the string a downward force and shearing said frangible means when the housing is set in the well, screw thread means detachably connecting said shoe to said string, and key means adapted to prevent a rotation of the screen with regard to the housing, whereby said string can be disconnected from the shoe by applying thereto a rotational force when the housing is set in the well.

6. A well screen structure comprising a tubular string adapted to be lowered into a well, a shoe detachably carried at the lower end of said string, a tubular screen affixed to said shoe and extending thereabove around said string, a tubular housing slidably surrounding said screen, said housing and string forming an annular chamber for said screen, annular packing members adapted to seal said chamber, frangible means locking said housing with regard to the string, packer means comprising anchoring slips outwardly mounted on said housing for setting said housing in a well, whereby said string, screen and shoe can be lowered with regard to the housing by applying to the string a downward force and shearing said frangible means when the housing is set in the well, screw thread means detachably connecting said shoe to said string, key means adapted to prevent a rotation of the screen with regard to the housing, whereby said string can be disconnected from the shoe by applying thereto a rotational force when the housing is set in the well, and latch means carried by said housing adapted to lock the screen in its lowered position with regard to the housing.

BESSIE MAY COLLINS,  
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WILFRED ST. MAUR  
ELMORE CRAKE.