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By their Attorney:
INSTALLATION FOR WELL CONTROL
EQUIPMENT

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This invention pertains to the art of drilling,
cementing and completing oil and gas wells, and
relates in particular to a method and apparatus
for the installation of well control equipment
in landing the outer or surface casing string.

Deep wells are commonly provided with a plu-
rality of concentric casing strings extending to
different depths from the surface. The outer
casing is known as the surface string and extends
usually to a depth prescribed by local regulations,
such as about from 400 to 1000 feet. A water
string is arranged within the surface string con-
centrically therewith, and extends usually ap-
proximately to the top of the oil bearing zone.
One or more oil strings may be arranged within
the water string and serve to bring the oil to
the surface or to accommodate the tubing string
through which the oil is produced.

Many methods and types of equipment have
been heretofore developed for installing, cement-
ing and landing these various casing strings, and
for installing and connecting thereto suitable
drilling riser and casing head equipment at the
surface. These methods, however, generally in-
clude certain drawbacks, such for example as a
considerable loss of rig time attendant the neces-
sity of waiting for the cement to set before con-
tinuing operations, a relatively poor control of
the well during the cementing and landing oper-
ations, etc.

It is therefore an object of this invention to
provide a method and an apparatus whereby the
surface casing may be landed and cemented, and
the control equipment at the surface may be in-
stalled and connected thereto immediately after
the cementing operation, without waiting for the
cement to set, thereby effecting a saving of from
to sixteen hours of rig time.

It is also an object of this invention to pro-
vide a method and an apparatus adapted to
eliminate the necessity of welding or otherwise
attaching the landing head to the surface casing
after the latter has been placed in the borehole,
thus greatly facilitating the landing and flanging
operations, obtaining a better control of the well,
and effecting a further saving in rig time.

It is also an object of this invention to pro-
vide a system adapted to assure a proper align-
ment of the landing head and of the surface
casing with the center or axis line of the well
as determined by the line of block travel.

It is also an object of this invention to provide
a system for the landing of the surface casing
affording an adequate foundation for the sup-
port of the surface and subsequent or inner
strings of casing or tubing dependent thereon.

These and other objects of this invention will
be understood from the following description of
the installation of a surface string and well head
control equipment according to the present inven-
tion, taken with reference to the attached
drawings, wherein Figures 1 to 4 inclusive illus-
strate diagrammatically and partly in cross-sec-
tion four consecutive steps in carrying out this
installation, and Fig. 5 shows another embodi-
ment of said installation.

Referring to the drawings, Fig. 1 shows a
preferred cellar detail departure which is desir-
able to realize fully the advantages of the present
invention. A suitable cellar floor is formed as
shown at 10 by pouring concrete with a form
11 placed in the center of the floor. The form
11 is made of any suitable material, such as
wood, iron, cast-iron, steel, etc., having a square
or circular shape and a cross-sectional area in
a horizontal plane of about from 12 to 16 square
feet. This form serves as a conductor box to
receive the sub-conductor, as will be shown here-
below. A cavity 12, from 4 to 20 feet deep is
formed for the sub-conductor within and below
the form 11.

After the cellar has been formed as illus-
trated in Fig. 1, the derrick is erected, the der-
rick sub-structure, generally indicated for ex-
ample at 14 and 15 in Fig. 2, being positioned
preparatory to installing the conductor. The
derrick floor 14 is provided with the customary
rotary table opening 16, substantially coaxial with
the cavity 12 and the center line of the derrick,
which normally coincides with the line of block
travel.

Referring to Fig. 2, the conductor pipe as-
ssembly or unit of the present invention consists
of an elongated tubular conductor element hav-
ing an upper portion 20 of a relatively larger
diameter, such for example as 30 inches, and
a lower or subconductor portion 21 having a rela-
tively smaller diameter such for example as 20
inches. The length of the conductor element
is regulated by the desired spacing of the landing
head with regard to the rotary sill, which is
necessary in order that the drilling riser and
well fittings may subsequently be positioned at
the proper level, as will be explained hereina-
below. In general, the length of the conductor
element may vary from about 10 to about 20 feet,
and that of the sub-conductor element from about
4 to about 20 feet.

The adjacent ends of the tubular members 20
and 21 are provided with connector means such as flange or plate members 23 and 25 respectively, formed integrally therewith, or permanently attached thereto by any desired means, such as welding, whereby the conductor and the sub-conductor may be attachably joined together by means of bolts 27 passing through said flanges. A parking ring 24 should preferably be provided between the abutting faces of the flanges 23 and 25 to form a fluid-tight seal therebetween. Owing to the larger diameter of the conductor 20, the flange or plate connection between the members 20 and 21 forms an internal annular shoulder 29 about the upper orifice of the sub-conductor 21, which shoulder is used according to this invention for purposes to be described hereinafter. The conductor 20 is open at its upper end 30, and is provided near said upper end with a radial flow outlet pipe connection 31, and near its lower end with a flushing pipe connection 33, which may have a considerably smaller diameter than the pipe 31.

The conductor 20 is also provided near its upper end with outwardly extending support or bracket members 35, provided with suitable locking means for attachment to the derrick structure, as will be described hereinafter.

In applying the method of the present invention, the form 1 of Fig. 1 is removed, and the conductor 20 is bolted to the sub-conductor 21 to form a single unit, which is lowered into the cell and is supported by means of brackets 35 from the sills or beams 37 forming part of the derrick structure. The supporting brackets 35 are spaced with regard to the sub-conductor plate 25 so that when the conductor unit is suspended from the sills 37, said plate 25 is substantially level with the cellar floor, and is thus correctly positioned to permit the subsequent installation of well fittings with respect thereto.

Before the unit is finally affixed to the sills 37, its center or axis line is aligned with the center line of the well to be drilled, as determined by the line of block travel. For purposes of this lateral adjustment, the brackets 35 are provided with radially elongated slots for the bolts 39, attaching the brackets 35 to the sills 37. With the conductor unit supported from the sills, cement or concrete is poured into the excavation 12, up to the plate 25 and substantially level with the floor of the cellar. After the cement has set, the plate 25, which may be circular or square in shape, and which has preferably a diameter larger than the conductor pipe 29, is firmly supported thereon.

Under certain conditions it may be desirable to provide a guide sleeve 40 within the conductor 20 for the purpose of guiding drilling tools from the large diameter conductor 20 to the relatively smaller diameter sub-conductor 21 without stabi- lizing at the annular shoulder 29. This guide sleeve comprises a tubular member 41, having an internal diameter equal to that of the sub-conductor, said tubular member being flared at the top to an external diameter substantially equal, but slightly less than the internal diameter of the conductor 20, whereby the guide sleeve is adapted for a sliding fit within the conductor pipe 29.

The guide sleeve 40 may be provided near its lower end with guide elements such as wing guides shown at 45 to centralize it within the conductor 20 and to align it in register with the sub-conductor 21. Two or more lifting or link elements, such as cables or rods 47 are affixed in any suitable manner to the flared portion of the guide sleeve, near its upper edge, being arranged diametrically opposite to each other and in close proximity to the inner wall of the conductor 20. These lifting rods may advantageously terminate in the form of a loop or eye 48, or similar suitable attachment device, at a level immediately above to open top of the conductor 20, and may be connected by a becket or bail 49. The becket 49 is preferably semi-circular in shape and, when in an operative position, as shown in the drawing, rests on the rim of the conductor without obstructing its opening, being however adapted to be engaged by a device such as a catline hook for the insertion or removal of the guide sleeve from the conductor. Upon insertion, the guide sleeve rests with its lower end on the annular shoulder 29.

With the conductor unit arranged as shown in the drawing, the hole for the surface casing may be provided by guiding a drill string and bit (not shown) through the guide sleeve to the sub-conductor and circulating the drilling fluid in the usual manner, for example, down the drill string and up through the annular space between the drill string and said sub-conductor and sleeve, and out through pipe connection 31.

Before installing the surface casing string by means of the present apparatus, as shown in Fig. 3, the guide sleeve 40 is removed from the conductor, the casing and the bore drilled therefor are measured for length, and a landing head 50 is attached by welding or threading to the uppermost casing joint 56, which operation can conveniently be effected in a shop prior to running the unit into the borehole.

The surface string landing or casing head used in the system of the present invention comprises a bowl-shaped element 50 of an outside diameter somewhat larger than that of the surface casing, which head is adapted to be connected to the uppermost casing joint and is provided with an upper flange 53. Extending radially from the bowl 50 are a plurality of spaced lugs 51, welded or otherwise integrally attached to the casing head 50. The downwardly-directed faces 55 of the lugs 51 are shaped and dimensioned in such manner as to seat on the annular shoulder 29 and thus to provide for the support of the surface string and of all subsequent dependent strings from the plate 25. If desired the lugs 51 may be attached to element 56 instead of 50.

In lowering the casing unit comprising the joint 56 of the surface string and the casing head 50 attached thereto, the flange 53 is first connected by bolts 59 to the lower flange 57 of a lifting nipple 60, and the assembly is then lowered into the well until the lugs 51 come to rest on the annular shoulder 29. The lugs 51 are built of such an external diameter that they are rigidly guided by the conductor 20 to land the surface casing 56 in axial alignment with the center line of the sub-conductor 21.

Should it be required, for some reason, to land the surface string in non-axial alignment with the sub-conductor, the bolts 27 connecting the conductor 20 with the sub-conductor 21 may be removed prior to the landing, which will permit the casing head 50 and surface casing 56 to be shifted together with the conductor 20 in a horizontal plane with regard to the sub-conductor. Such operation may, for example, be necessary when the centering of the sub-conductor 21 is faulty, or when a drive pipe similar to the sub-conductor 21 had been substituted therefore, it being impractical to align such drive-pipe with the well center.
After the head 50 has been landed on the plate 25, the surface string is cemented in place by pumping a cement charge down through the lifting nipple 60 and circulating fluid out through the pipe connection 31. If the cement charge fills all the annular space between the surface string and the walls of the borehole and sub-conductor 21 excess cement may be flushed out through the lower pipe connection 33. As soon as the cementing operation is completed, and without the necessity of waiting for the setting of the cement, the conductor 20 is disconnected from the sub-conductor 21 and end from the sill 51, and is stripped over the lifting nipple. The lifting nipple is then disconnected and removed by breaking the connection between flanges 53 and 51, whereupon a riser, such for example as generally shown at 61 in Fig. 4 is connected to the landing head in preparation to further controlled drilling through the surface casing.

Fig. 5 shows a slightly modified embodiment of the device illustrated in Figs. 1-4, in which the connection between the conductor and the sub-conductor, instead of the arrangement involving flanges 23 and 25 and bolts 27 shown in Fig. 2, involves an arrangement comprising a flange forming a slip bowl 509 welded to, or otherwise permanently attached to, the sub-conductor, into which the lower end of the conductor 200 is inserted to form a slip joint therewith.

The guiding lugs 510 of the surface string, which are shown attached to the upper casing joint instead of to the casing head as in Figs. 1-4, are provided with slanting or wedge-shaped extensions 511, which project downwards from the flat portion of the lugs seating on the annular collar, and serve to center the casing in the flange forming with the sub-conductor, a function which is fulfilled in the embodiment of Figs. 1-4 by the slanting internal shoulder of the flange 23 attached to conductor 20, as shown in Fig. 2. It is understood that the sparge features shown in Fig. 5 can be each used with the structure of Figs. 1-4, while the various features shown in Figs. 1-4 can in turn be used with the embodiment of Fig. 5.

We claim as our invention:

1. For use in a well derrick casing string, a tubular conductor unit for installing a surface casing string, said conductor unit comprising a lower tubular sub-conductor element of relatively smaller diameter adapted to be permanently embedded in a cement mixture immediately below the casing floor, a removable upper conductor element of a diameter larger than that of the sub-conductor element adapted to extend in axial register with the sub-conductor element above the casing floor, connector means for detachably affixing said elements to each other and anchoring them to the casing floor, said connector means forming between said elements an annular shoulder transversely disposed therebetween, spaced radial lugs exteriorly carried by said connector element near the upper end thereof, and laterally adjustable means for detachably locking said support means to the derrick structure, whereby said conductor unit can be centered with regard to the derrick floor.

2. The apparatus of claim 1, comprising a tubular guide sleeve removably inserted in the conductor element, said guide sleeve having its lower end seated on the annular shoulder of the connector means, said lower end having radial dimensions substantially equal to those of the sub-conductor element, the upper end of said guide sleeve being flared to form a funnel having radial dimensions substantially equal to those of the connector element.

3. The device of claim 2, having radial centering means outwardly carried by said tubular guide sleeve, said centering means having a radial length slightly less than and the difference between the internal radius of the conductor element and the outside radius of the tubular guide sleeve.

4. The device of claim 2, having link means attachable to the flared portion of the guide sleeve near the outer edge thereof for lowering and lifting said guide sleeve within the conductor element.

5. The apparatus of claim 1, having radially arranged pipe connection means through the walls of the conductor element.

6. In a well installation comprising a derrick having an opening through the floor thereof, a cell and a cavity in the cellar floor in substantial alignment with the derrick floor opening, the improvement comprising a conductor unit for installing a surface casing string, said unit comprising a tubular sub-conductor element of relatively smaller diameter permanently embedded in a cement mixture in said cavity in the cellar floor, a removable upper conductor element of a diameter larger than that of the sub-conductor element in axial register with the sub-conductor element above the cellar floor, connector means detachably affixing the lower end of the conductor element to the upper end of the sub-conductor element, said connector means forming between said elements an annular shoulder transverse to the axis thereof, support means exteriorly carried by the conductor element near the upper end thereof, and laterally adjustable centering means detachably locking said support means to the derrick structure in substantial alignment with said cavity in the cellar floor.

7. In a well derrick cellar structure, in combination, a conductor unit comprising a lower tubular sub-conductor element of relatively smaller diameter permanently embedded in a cement mixture below the cellar floor, a removable upper conductor element of a diameter larger than that of the sub-conductor element in axial register with the sub-conductor element above the cellar floor, connector means detachably affixing said elements end to end to each other, said connector means being anchored to the cellar floor, said connector means forming between said elements an annular shoulder transverse to the axis of said elements, support means exteriorly carried by the conductor element near the upper end thereof, laterally adjustable centering means detachably locking said support means to the derrick structure, a surface casing unit extending through the conductor unit coaxially therewith, said casing unit comprising a casing string having an outside diameter smaller than the inside diameter of the sub-conductor element, a casing head connected in said string, said casing head having an outside diameter smaller than the inside diameter of the conductor element but larger than that of the sub-conductor element, and spaced radial lugs exteriorly carried by said casing head, said lugs seating on said annular collar of the connector means to support the casing unit thereon, the spaces between said lugs forming flow channels means for fluid circulation between the annular space around the casing string below said connector.
means and the annular space around the casing string above the connector means.

8. For use in a well structure comprising a derrick having an opening through the floor thereof in substantial alignment with the well bore, a casing under the derrick floor and a cavity in the cellar floor substantially co-axial with the well bore. In combination, a conductor unit comprising a lower tubular sub-conductor element of relatively smaller diameter permanently embedded in a cement mixture in said cavity, a removable upper conductor element of a diameter larger than that of the sub-conductor element in axial register with the sub-conductor element above the cellar floor, connector means anchored to the cellar floor detachably affixing said elements to each other, said connector means forming between said elements an annular shoulder transverse to the axis of said elements, support means exteriorly carried by the conductor element near the upper end thereof, laterally adjustable centering means detachably locking said support means to the derrick, radial flow pipe connection means through the walls of the conductor element, a surface casing unit extending into the well bore through the conductor unit co-axially therewith, said casing unit comprising a casing string having an outside diameter smaller than the inside diameter of the conductor element but larger than the inside diameter of the sub-conductor element, and spaced radial lugs exteriorly carried by the casing unit below the casing head, said lugs seating on said annular collar of the connector means to support the casing unit thereon, said lugs forming therebetween channel means for fluid circulation between said radial flow pipe connection means, the annular space around the casing string within the conductor element and the annular space around the casing string in the well bore below said conductor element.

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