INTRODUCTION TO
WELL CONTROL

SECOND EDITION

THE UNIVERSITY OF TEXAS AT AUSTIN
Petroleum Extension Service

PETEX

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INTRODUCTION

A blowout rising to the surface can be a spectacular event (fig. 1). Many barrels of fluid can move up the hole and to the surface under tremendous pressure. A blowout is the uncontrolled release of formation fluids under high pressure. Before a well blows out, it kicks. A kick is the entry of enough formation fluids into the wellbore so that when the driller shuts in the well (stops the mud pumps and completely seals the well), the intruded fluids exert pressure in the well. If crew members fail to recognize that the well has kicked and do not take proper steps to control it, it can blow out.

Blowouts can destroy expensive drilling rigs, cause the loss of large amounts of oil and gas, and bring about serious injury or death to members of the drilling crew. Most petroleum fluids (hydrocarbons) ignite easily; so, if they reach the surface, a fire usually results. Not all blowouts reach the surface, however. Sometimes, formation fluids can flow into another underground formation at a different depth from the flowing formation. This kind of flow is an underground blowout and can be very difficult to control.

Most blowouts occur because somebody made a mistake. So, a drilling crew that is trained to (1) recognize the warning signs of a kick, (2) take proper steps to shut in and control the well when it kicks, (3) install blowout prevention equipment correctly, and (4) maintain the equipment so that it works correctly when needed, can prevent most blowouts. The key to preventing blowouts is recognizing and controlling kicks before they become blowouts.

Figure 1.

PART I
Causes of a Kick

Part II
Recognizing a Kick

So far we have covered what causes a kick. Now let's apply this knowledge to the work on the rig. The main concerns on the job are discovering that a kick has occurred and then controlling it. Remember that most kicks occur in normal-pressure formations and that they are often caused by human error. Even if a kick does occur, it doesn't have to automatically result in a blowout. The key is early detection. Recognizing that a kick has occurred as early as possible lessens the danger and provides plenty of time to control it.

Kicks don't just occur. They develop in a predictable sequence of events and give several visible warning signs. This section concentrates on the warning signs you should be able to recognize on the rig floor and around the mud system.

Kicks occur below the earth's surface. You cannot see them directly, but they give clues you can see on the rig floor and in the returning mud. It is much like being on a submarine, cut off from what's happening, but having instruments, gauges, and other indicators available for guidance.

The rig's circulating system is vital to recognizing and controlling a kick. Figure 30 is a schematic of a simple circulating system. The mud pump (most rigs have more than one) picks up drilling mud from the tanks and pumps it down the drill stem and to the bit. At the bit,

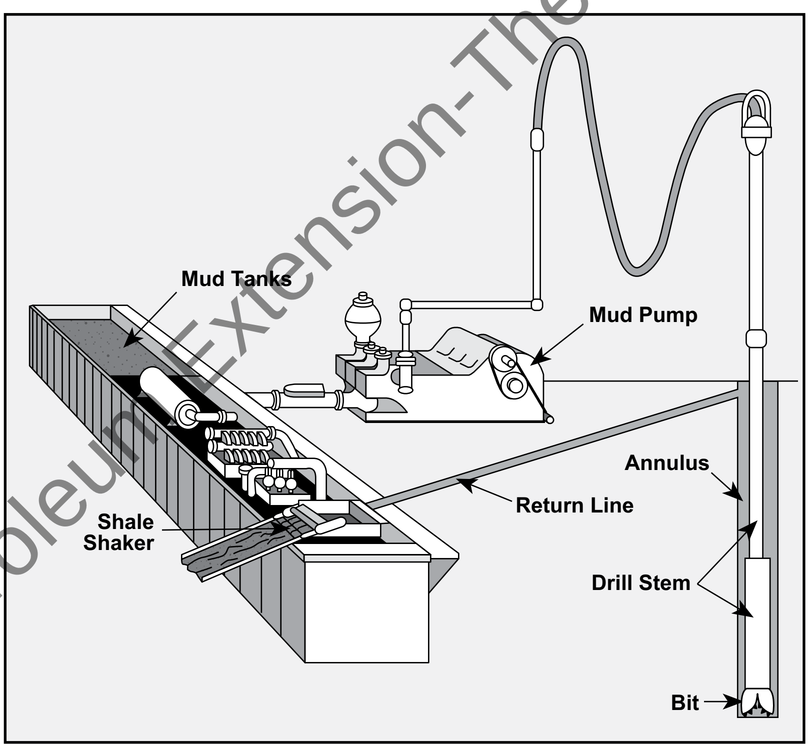

Figure 30.

Part III Killing a Kick

So far this book has covered what causes kicks and how to detect them. Now it will cover what to do when a kick occurs. Obviously, crew members should remain calm and not panic. Most kicks can be safely controlled by applying known and proven techniques.

Specific procedures and equipment differ, depending on the operator and drilling company's policies, the rig's location, and the type of equipment on the rig. This part looks at general procedures and the primary methods for killing a kick. But first, let's take a closer look at what happens downhole when a kick develops.

Figure 50 is a schematic of a well. It shows some basic well-control equipment including a choke, casing pressure gauge, mud pump, drill pipe pressure gauge, and blowout preventers. It is not an exact representation of a rig, of course, but a simplified version. The diagram includes only items that directly concern well control. The mud pump is at *C*. It forces fluid into and down the drill stem. The BOPs or blowout preventers are at *E*. When blackened in future diagrams, they are closed. In figure 50, they are open. The choke is at *A*. It is closed. When open, flow is shown. When the BOPs are closed, the top of the well is shut in, and mud and kick fluids cannot be circulated through the normal route. In most cases, they are circulated out through an open choke.

The amount of force, or pressure, needed to move the mud through the drill stem and back up to the surface is called circulating pressure. This force overcomes friction as the mud flows through the drill stem, out the bit nozzles, and back up the annulus. The drill pipe pressure gauge measures the circulating pressure as the fluid enters the drill stem. In figure 50, the drill pipe pressure gauge is at *D*. During normal drilling operations,

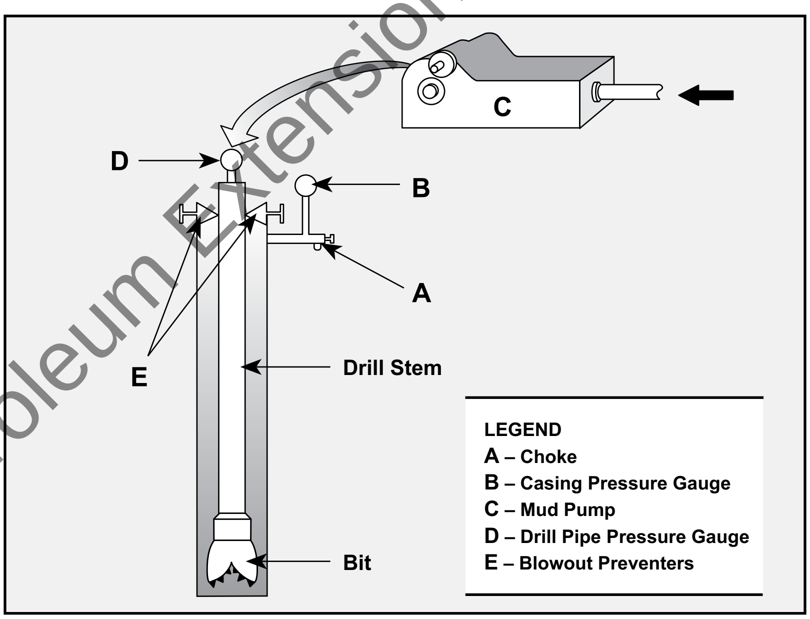

Figure 50.

PART IV
Well-Control Equipment

This section examines some typical well-control equipment designed to detect, handle, and eliminate kicks before they develop into blowouts. The intent is to familiarize you with the approximate locations and general functions of this equipment. You will receive instructions on the actual installation, operation, and maintenance of BOP equipment as part of your on-the-job training. The equipment is divided into the categories of blowout preventers, accumulators, equipment like control panels and drill stem valves, choke manifolds, mud-gas separators, and mud system equipment.

BLOWOUT PREVENTER STACKS

Most rigs have several blowout preventers stacked on top of each other. On land rigs and on jackup and platform rigs offshore, the stack is usually located directly under the rig floor (fig. 85). On offshore floating rigs, the stack is placed directly above the wellhead on the seafloor. The stack consists of several large valves capable of withstanding high pressure. Designed to shut in the well, the BOPs prevent a surface blowout from occurring.

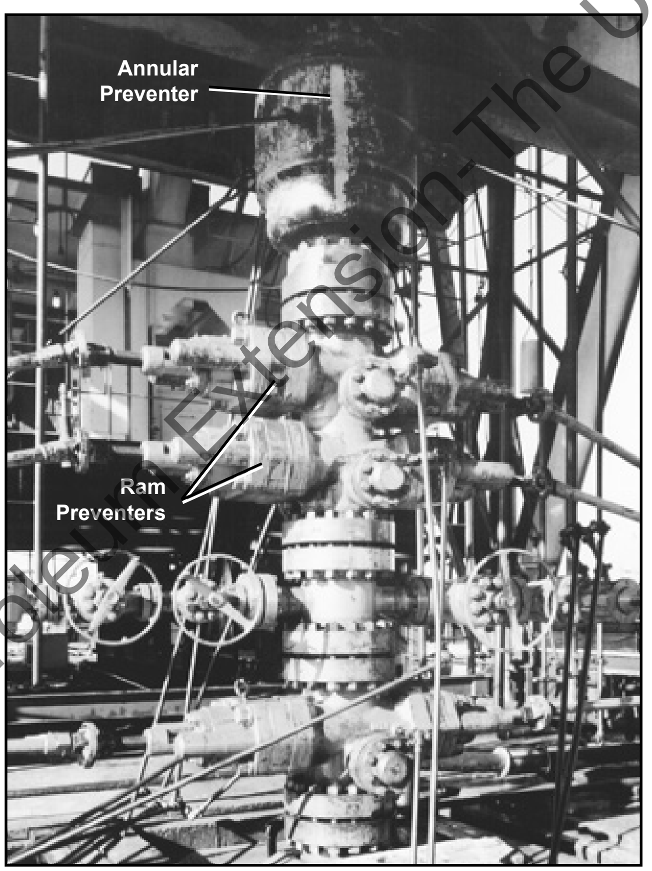

Figure 85.

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