Case No.

1,400

Application, Transcript,
Small Exhibits, Etc.

[redacted]

BEFORE THE
OIL CONSERVATION COMMISSION
STATE OF NEW MEXICO
Santa Fe, New Mexico

March 19, 1958

TRANSCRIPT OF HEARING

Case 1400

DEARNLEY - MEIER & ASSOCIATES
INCORPORATED
GENERAL LAW REPORTERS
ALBUQUERQUE - SANTE FE
3-6691 2-2211

BEFORE THE
OIL CONSERVATION COMMISSION
STATE OF NEW MEXICO
Santa Fe, New Mexico

March 19, 1958

IN THE MATTER OF:

Application of Gulf Oil Corporation for a dual completion. Applicant, in the above-styled cause, seeks an order authorizing the dual completion of its Naomi Keenum Well No. 2 located 660 feet from the South line and 1980 feet from the East line of Section 14, Township 21 South, Range 37 East, Lea County, New Mexico, in such a manner as to permit the production of oil from the Terry-Blinebry Oil Pool and to permit the production of gas from the Tubb Gas Pool through parallel strings of tubing.

Case 1400

BEFORE: Mr. Daniel S. Nutter, Examiner

TRANSCRIPT OF HEARING

MR. NUTTER: The next case on the docket will be Case No. 1400.

MR. PAYNE: Application of Gulf Oil Corporation for a dual completion.

MR. KASTLER: If the Commission please, my name is Bill Kastler, representing Gulf Oil Company. Our two witnesses for both Case 1400 and 1401 are Gerald J. Savage and Charles E. Mace. I wonder if they could be sworn in both cases at this time.

MR. NUTTER: They may.

MR. KASTLER: Mr. Savage, will you please take the stand?

(Witnesses sworn.)

GERALD J. SAVAGE

called as a witness, having been first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. KASTLER:

Q Will you state your full name, your position and where you are employed?

A I am Gerald J. Savage. I am employed as production geologist by the Gulf Oil Corporation in Roswell, New Mexico.

Q Have you previously appeared before the New Mexico Oil Corporation Commission and qualified as an expert witness?

A Yes, sir, I have.

MR. KASTLER: Mr. Nutter, are the witness's qualifications acceptable?

MR. NUTTER: They are.

Q Mr. Savage, have you any familiarity with the geological picture in the area around the Naomi Keenum No. 2 Well?

A Yes, I am generally familiar with the geology in that area.

Q Have you prepared a location plat for an exhibit here as Exhibit No. 1?

A Yes, sir, I have labeled this Exhibit No. 1 in 1400.

Q Will you please explain what is shown on Exhibit No. 1 and how it is designated?

A On Exhibit 1 is shown the pertinent Gulf lease, the

the West Half of the South Quarter of Section 14, Township 21 South, Range 37 East. It is outlined in yellow and the pertinent Gulf 1, the NK No. 2 circled and marked in red.

Q Does this plat also show the surrounding and offset operators?

A Yes, it does.

Q Have they been notified of this application?

A Yes, sir, they have been notified of the application for dual completion.

Q Would you state what other wells are shown on Gulf's NK Lease?

A On Gulf NK Lease is shown the No. 1 NK, a direct North offset to the No. 2 and it is a Blinebry producer.

Q Now, will you please give the history of NK No. 2?

A The well was originally completed in the Drinkard in March of 1953. However, this production declined to a non-commercial rate and this pay was abandoned in October 1957. The well was then plugged back and completed as a gas well in the Tubb Gas Pool. It is planned to complete the Blinebry oil pay in the same zone as our NK No. 1.

Q Have you prepared or caused to be prepared as Exhibit No. 2 in this case a well log?

A Yes, I have, and I have labeled it Exhibit No. 2.

Q Does this log show the formations penetrated by NK No. 2, and does it also show the intervals perforated?

A Yes, it does. It shows the formations penetrated, and it shows the proposed perforations in the Blinebry zone, a depth of 5,698 feet to 5,800 feet. It also shows the perforated interval in the Tubb zone which flowed on fifteen minute Oil Conservation Commission test on December 10th, 1957 through two and seven-inch tubing and four inch orfice at the rate of six million cubic feet of gas per day with a 700 pound back pressure. The estimated open flow volume of this well is eight million cubic feet of gas per day.

Q Does it appear that the Blinebry will be oil productive rather than gas productive?

A It is my opinion that the Blinebry zone in the NK No. 2 will be oil productive inasmuch as it is at the same structural level approximately as our No. 1, and it is planned to perforate and treat that same zone.

MR. KASTLER: Mr. Nutter, these are the only questions I have in this case for this witness. I would like to move at this time to admit Exhibits 1 and 2 into evidence.

MR. NUTTER: Is there objection to Gulf's Exhibits No. 1 and 2 in Case 1400? If not, they will be received.

CROSS EXAMINATION

By MR. NUTTER:

Q Mr. Savage, is the interval for completion for both of these zones within the vertical limit of the Blinebry Pool and the Tubb

Pool? A Yes, sir, they are.

Q Is the well located within the horizontal limits of each pool?

A To my knowledge they are.

MR. NUTTER: I believe that's all. Any further questions? If not, he may be excused.

(Witness excused.)

CHARLES E. MACE

called as a witness, having been first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. KASTLER:

Q Will you please for the record state your name, your position and how long you have been employed in that position by Gulf?

A My name is Charles E. Mace, petroleum engineer with Gulf Oil Corporation in Roswell, New Mexico. I have been employed since June of 1950, or for approximately eight years.

Q Have you previously appeared and testified before the New Mexico Oil Conservation Commission? A No, I have not.

Q Will you outline your educational background and your experience in New Mexico and West Texas?

A I have received a Bachelor Degree in Mining with a Petroleum Degree option from the Missouri School of Mines at Rolla June of 1950, and at that time I was employed by the Gulf Oil

Corporation, and for the last three years I have been concerned with production problems essentially with West Texas and New Mexico.

Q Have you been continually employed as an oil production engineer since your graduation? A Yes, sir.

MR. KASTLER: Mr. Nutter, is this witness satisfactorily qualified?

MR. NUTTER: Yes, he is.

Q Are you familiar with Gulf's application to dually complete its NK No. 2? A Yes, I am.

Q Are you familiar with the type of installation proposed for this dual completion? A Yes, I am.

Q Have you prepared or caused to be prepared a schematic diagram to illustrate this proposed completion?

A Yes.

Q Is this marked Exhibit No. 3?

A Yes, sir.

Q Will you please explain Exhibit No. 3?

A It shows a surface string of 12 - 3/4" OD casing at 212 feet, and the cement was circulated. There is an intermediate casing of 8 - 5/8" OD set at 2999, cemented with 1350 sacks, and the cement top is found at 588. The oil string is 5 - 1/2" OD set at 7193, cemented with 735 sacks, and the cement top at 2970' from the surface. The present plug back total depth, the well has been plugged back at the 6700'.

Now the well is currently perforated in the Tubb Gas Zone at 6110 to 6248. Now, pending permission of the Commission, we plan to perforate the Blinebry zone to approximately 5698 to 5800 and then we would install this tubing string, the dual tubing string, the two inch Hydril J-55, with the Baker model "A" packer parallel Anchor flow tube on the bottom of it, and prior to running this tubing we would run into the well bore two Baker packers as shown on the diagram, the upper packer would be at about 5,668 feet, the lower packer about 5,879 feet, and then we would run the two inch tubing with the Baker Model parallel flow tube on the bottom and seat it in the two packers. Then we would run one and a quarter inch non upset J-55 tubing and set it in the upper portion of the parallel Anchor flow tube. By this arrangement we would then flow the Tubb gas into the well bore below the lower packer as shown in green. It would come up into the parallel flow tube and switch into the one and a quarter inch tubing and come to the surface.

The Blinebry then would enter the well bore between the two packers, it would go into the parallel Anchor flow up and up into the two inch tubing and to the surface.

Q Could the Blinebry oil be pumped?

A It could be in this installation at a later date if so necessary.

Q Can adequate tests be performed to insure a completion separation of the respective zones and determine if any leakage

between them occurs?

A Yes, I believe they can.

Q Will Gulf comply with such further operating test reports and procedures required by the Commission if the application is approved?

A Yes.

Q Is this proposed method of completion feasible and practicable?

A Yes.

Q Has Gulf previously filed application for administrative approval of an 80 acre non-standard Tubb gas unit?

A Yes, by an Order No. SP-408, this non-standard gas proration unit was approved by the Commission January 12, 1958.

Q What pipeline connections are made or proposed?

A We plan to contract the Tubb gas to Permian Basin Pipeline.

Q It has already been contracted, is that not so?

A Yes.

Q Is this application in the interest of conservation of oil and gas?

A Yes.

Q In your opinion will it protect correlative rights if granted?

A Yes, sir.

MR. KASTLER: That's all the questions I have of this witness. At this time I would like to move the introduction of Exhibit No. 3.

MR. NUTTER: Is there objection to introduction of Exhibit 3? If not it will be received. Anyone have any questions of the

witness?

CROSS EXAMINATION

By MR. NUTTER:

Q Mr. Mace, how do you spell your name, please?

A M-a-c-e.

Q Mr. Mace, I didn't catch the location of the two packers. Would you give me those again?

A Yes, sir, the packers, the upper packer will be at approximately 5,668 feet and the lower packer at approximately 5,879 feet.

Q These are both permanent type packers?

A Yes, sir, they are.

Q Can you describe for me what the head, that located at the Model "A" parallel seal nipple or just below it, would you describe what this head is that joins the two strings of tubing?

A That is a piece of equipment wherein there are two openings so that the two inch tubing will be in the one opening and that seemingly can be run when we run the two inch. In other words, the Baker parallel flow tube will be round on the bottom of the two inch tubing and at that time there will be an opening for the one and a quarter inch and we will run the one and a quarter inch and seat that, it will seat and seal off in this receptacle.

Q You say you run the head on the large string of tubing when you run the header?

A Yes, sir.

Q Then you run the smaller string of tubing at a later time?

A Yes, sir.

Q Does this screw into the head or is it a seal joint?

A It seals, as I understand it, yes, sir. I might enlarge that I believe it is possible to run the two strings simultaneously if you so desire, or just run, like I said, we probably will run the two inch with the Model "A" flow tube and then run the one and a quarter inch afterwards and seat it in the head.

Q How does the two inch string of tubing fasten into the head?

A I would, the two inch tubing into the head would be screwed in. It would be made up as any joint would be.

Q What seal is provided at the point where the inch and a quarter tubing goes into the head? Are there seal rings there or just what?

A Yes, sir, they are rings or packing, seemingly that the one and a quarter inch would fit in and seal off.

Q What evidence is there that this would provide an adequate seal to separate the two formations?

A We can check by closing in the two well strings at the surface with use of recording gauges and then after they have stabilized and open up one of the zones and then observe the pressure on the closed-in zone, see if it changes.

Q You say that the two inch depends on a screwed joint?

A Yes, sir, that is my understanding.

Q To provide the seal, would there be any commingling of the

production from the two zones if a leak occurred at the junction of the inch and a quarter tubing and the head?

A At the junction of the inch and a quarter and the head? No, sir, the gas which would be that as shown by green, the Tubb gas, it would be in the annular space, it would not be in contact with the Blinebry oil.

Q Would you define for me what the cross section of this Model "A" parallel Anchor flow tube looks like?

A Yes, sir, the Model "A" parallel flow tube is a full opening tube.

Q What's the outside diameter of that?

A I'm sorry but I don't believe the outside diameter of the parallel flow tube, this is the Baker brochure, Mr. Nutter. I am sorry but I can't seem to put my finger on it. I can be sure and get that for you and advise you of the outside diameter. The Baker brochure, it shows the combination tubing strings that could be run into various well bores, and for your information the head that you asked me to describe, it looks like this, the two inch would be in the larger opening and you would seat your one and a quarter inch in the lower.

MR. NUTTER: Can you introduce this as an exhibit?

MR. KASTLER: Yes.

RE-DIRECT EXAMINATION

By MR. KASTLER:

Q Mr. Mace, will you present as Exhibit No. 4 the brochure that you have from the packer tools?

A Yes, I would be happy to introduce Exhibit No. 4.

MR. KASTLER: I ask that that be stamped and labeled as Gulf Exhibit No. 4, and introduced as evidence.

MR. NUTTER: Without objection, Gulf's Exhibit No. 4 will be introduced in this case.

RE-CROSS EXAMINATION

By MR. NUTTER:

Q What I'm interested in actually is the cross sectional area of the two parallel flow sections in that parallel flow tube, and whether they approximate inch and a quarter tubing cross sectional area or two inch tubing or just what.

A Yes, sir, I might mention that if the two inch tubing had been used to flow the tube to the surface, a bomb could be run clear to the bottom. In other words, the opening is the full opening through the parallel flow tube for the string that comes up from the bottom. In other words, a bomb could have been run from the surface through the parallel Anchor flow tube clear to the bottom of the tubing string. Of course, in this instance we do not use or advocate the use of the two inch for the Tubb gas, we are using one and a quarter, but that is a combining of one and a quarter and the two inch Hydril is the acceptable combination for five and a half inch casing.

Q Is the portion of the parallel flow tube which is open to the Blinebry zone full opening?

A No, sir, it is not full opening.

Q So the Blinebry production will be restricted in that section of the flow tube below the head, is that correct?

A As I understand it, that is correct. It's kind of a parallel, the one is full opening and the other is just on the side of it allows the Blinebry oil to come in on the side and then adjacent to it and then rise up and get into the two inch tubing.

Q What is the length of this pipe in which you will have a restriction?

A The parallel flow tube, as I remember seeing it in Hobbs, is ten feet long.

Q Do you think that this will be detrimental to the flowing efficiency of the Blinebry zone?

A No, sir, I do not.

Q Do you think that fluid levels will always be such in the Blinebry zone that the zoning can be pumped?

A Yes, sir, I do.

MR. NUTTER: Are there any further questions of Mr. Mace? If not he may be excused.

(Witness excused.)

Is there anyone that wishes to offer anything in Case 1400? We will take the case under advisement and take the next Case 1401.

C E R T I F I C A T E

STATE OF NEW MEXICO)
: SS
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Court Reporter, do hereby certify that the foregoing and attached transcript of proceedings before the New Mexico Oil Conservation Commission at Santa Fe, New Mexico, is a true and correct record to the best of my knowledge, skill and ability.

IN WITNESS WHEREOF I have affixed my hand and notarial seal this 31st day of March, 1958.

Ada Dearnley
Notary Public-Court Reporter

My commission expires:

June 19, 1959.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 1400, heard by me on 3-19, 1958.

....., Examiner
New Mexico Oil Conservation Commission

DEARNLEY - MEIER & ASSOCIATES
INCORPORATED
GENERAL LAW REPORTERS
ALBUQUERQUE, NEW MEXICO
3-6691 5-9546

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF THE STATE OF NEW
MEXICO FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 1400
Order No. R-1150

APPLICATION OF GULF OIL CORPORATION
FOR AN ORDER AUTHORIZING AN OIL-GAS
DUAL COMPLETION IN THE TERRY BLINEBRY
OIL POOL AND THE TUBB GAS POOL IN LEA
COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on March 19, 1958, at Santa Fe, New Mexico, before Daniel S. Nutter, Examiner duly appointed by the New Mexico Oil Conservation Commission, hereinafter referred to as the "Commission," in accordance with Rule 1214 of the Commission Rules and Regulations.

NOW, on this 3rd day of April, 1958, the Commission, a quorum being present, having considered the application, the evidence adduced and the recommendations of the Examiner, Daniel S. Nutter, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Gulf Oil Corporation, is the owner and operator of the Naomi Keenum Well No. 2, located 660 feet from the South line and 1980 feet from the East line of Section 14, Township 21 South, Range 37 East, NMPM, Lea County, New Mexico.

(3) That the applicant proposes to dually complete the above-described Naomi Keenum Well No. 2 in such a manner as to permit the production of oil from the Terry Blinebry Oil Pool and gas from the Tubb Gas Pool through parallel strings of tubing.

(4) That the mechanics of the proposed dual completion are feasible and in accord with good conservation practices.

(5) That approval of the subject application will not cause waste nor impair correlative rights.

(6) That the subject application should be approved.

IT IS THEREFORE ORDERED:

That the applicant, Gulf Oil Corporation, be and the same is hereby authorized to dually complete its Rhemi Keesum Well No. 2, located 660 feet from the South line and 1980 feet from the East line of Section 14, Township 21 South, Range 37 East, NMPM, Lea County, New Mexico, in such a manner as to permit the production of oil from the Terry Blinebry Oil Pool and the production of gas from the Tubb Gas Pool through parallel strings of tubing.

PROVIDED HOWEVER, That subject well shall be completed and thereafter produced in such a manner that there will be no commingling within the well-bore, either within or outside the casing, of gas, oil and gas, or oil produced from either or both of the separate strata,

PROVIDED HOWEVER, That prior to the actual dual completion the operator shall make pressure tests of the casing to prove that no casing leaks exist. In the event a casing leak is apparent the operator shall take appropriate steps to adequately repair the leak. The results of these tests shall be reported to the Commission on Form C-103.

PROVIDED FURTHER, That upon the actual dual completion of such subject well applicant shall submit to the appropriate District Office of the Commission copies of Oil Conservation Commission Form C-103, Form C-104, Form C-110, and Form C-122, outlining the information required on those forms by existing Rules and Regulations, and two copies of the electric log of the well.

PROVIDED FURTHER, That said subject well for dual completion and production shall be equipped in such a way that reservoir pressures may be determined separately for each of the two specified strata, and further, be equipped with all necessary connections required to permit recording meters to be installed and used at any time as may be required by the Commission or its representatives, in order that natural gas, oil, or oil and gas from each separate stratum may be accurately measured and the gas-oil or gas-liquid ratio thereof determined, and

PROVIDED FURTHER, That the operator shall make any and all tests, including segregation and packer-leakage tests upon completion and annually thereafter during the Gas-Oil Ratio Test Period for the Terry-Blinebry Oil Pool, commencing in the year 1959, and whenever the packer is disturbed, but not excluding any other tests and/or determinations as deemed necessary by the Commission; the original and all subsequent tests shall be witnessed by representatives of offset operators if any there be at their election, and the results of each test, properly attested to by the applicant herein and all witnesses, shall be filed with the Commission within fifteen (15) days after the completion of such tests, and further, that applicant shall file with the Commission in duplicate a packer-setting affidavit, which affidavit shall be due within fifteen (15) days of the dual completion or whenever the packer is disturbed, and

[redacted] That upon the actual dual completion of such subject well, applicant shall submit to the Commission a diagrammatic sketch of the mechanical installation which was actually used to complete and produce the zone between the strata, and a special report of production, gas-oil ratio or gas-liquid ratio, and reservoir pressure determination for each producing zone or stratum immediately following completion.

[redacted] That jurisdiction of this cause is hereby [redacted] for such further order or orders as may seem necessary or convenient for the prevention of waste and/or protection of correlative rights; upon failure of applicant to comply with any requirement of this order after proper notice and hearing the Commission may terminate the authority hereby granted and require applicant or its successors and assigns to limit its activities to regular single-zone production in the interests of conservation.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

EDWIN L. MECHEM, Chairman

MURRAY E. MORGAN, Member

A. L. PORTER, Jr., Member & Secretary

ir/

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

Date March 20, 1958

CASE 1400 Hearing Date 3/19/58 Santa Fe: DSN

My recommendations for an order in the above numbered cases are as follows:

Enter an order authorizing the applicant, Gulf Oil Corporation, to dually complete its Naomi Keenum Well No. 2 located 660 feet from the South line and 1980 feet from the East line of Section 14, Township 21 South, Range 37 East. Said well shall be completed for the production of oil from the Terry Blinebry Oil Pool and the production of gas from the Tubb Gas Pool through parallel strings of tubing. Applicant proposes to flow the Blinebry oil through 2 inch Hydrill "A" J-55 tubing and to flow the Tubb gas through 1¼ inch NU J-55 tubing. Applicant further proposes to use a Baker Model "A" parallel anchor flow tube. While this type of equipment has never previous to this time been approved by the Commission, it is believed that it will provide an adequate and effective means of separation of the fluids from the two reservoirs. The oil produced from the Terry Blinebry can be pumped to the surface if necessary.

Staff Member
Examiner

No. 8-58

DOCKET: EXAMINER HEARING MARCH 19, 1958

Oil Conservation Commission 9 a.m. Mabry Hall, State Capitol Santa Fe, N. M.

The following cases will be heard before Daniel S. Nutter, Examiner:

CASE 1368: Application of Ambassador Oil Corporation for an order amending Order No. R-1110. Applicant, in the above-styled cause, seeks an order amending Order No. R-1110 to substitute the Vickers-Etz Well No. 2, NE/4 NE/4 Section 30, and the Vickers-Etz Well No. 3, SW/4 NE/4 Section 30, as water injection wells in lieu of the Carper Wheatley Well No. 1, SW/4 SE/4 Section 29, and Texas Trading State Well No. 3, NE/4 NW/4 Section 32, all in Township 16 South, Range 31 East, Eddy County, New Mexico.

CASE 1395: Application of Graridge Corporation for approval of a unit agreement. Applicant, in the above-styled cause, seeks an order approving its North Caprock-Queen Unit for purposes of secondary recovery in the Caprock-Queen Pool in Lea and Chaves Counties, New Mexico. Said unit comprises 2,887 acres, more or less, of State of New Mexico and patented lands located in Township 12 South, Range 31 East, Chaves County, New Mexico, and Township 12 South, Range 32 East, and Township 13 South, Range 32 East, Lea County, New Mexico.

CASE 1396: Application of Continental Oil Company for a dual completion. Applicant, in the above-styled cause seeks an order authorizing the dual completion of its Hawk B-3 Well No. 4 located 1980 feet from the North line and 660 feet from the East line of Section 3, Township 21 South, Range 37 East, Lea County, New Mexico, in such a manner as to permit the production of oil from the Terry-Blinebry Oil Pool and gas from the Tubb Gas Pool through parallel strings of tubing.

CASE 1397: Application of Warren-Bradshaw Exploration Company for an exception to Rule 309 of the Commission Rules and Regulations. Applicant, in the above-styled cause, seeks an order authorizing the production of more than eight wells into a common tank battery and authorizing the commingling of production from two basic State of New Mexico leases, comprising the W/2 NW/4, W/2 SW/4, and SE/4 SW/4 of Section 21, and the NE/4 of Section 29, respectively, Township 17 South, Range 33 East, Lea County, New Mexico.

CASE 1398: Application of Sinclair Oil & Gas Company for a non-standard gas proration unit. Applicant, in the above-styled cause, seeks an order establishing a 160-acre non-standard gas proration unit in the Tubb Gas Pool comprising the W/2 SW/4, SE/4 SW/4, and SW/4 SE/4 of Section 26, Township 21 South, Range 37 East, Lea County, New Mexico, said unit to be dedicated to the applicant's J. R. Cone "A" Well No. 1 located 660 feet from the South and West lines of said Section 26.

CASE 1399:

Application of Sinclair Oil & Gas Company for a non-standard gas proration unit. Applicant, in the above-styled cause, seeks an order establishing a 160-acre non-standard gas proration unit in the Blinebry Gas Pool comprising the W/2 SW/4, SE/4 SW/4, and SW/4 SE/4 of Section 26, Township 21 South, Range 37 East, Lea County, New Mexico, said unit to be dedicated to the applicant's J. R. Cone "A" Well No. 2 located 1980 feet from the South line and 660 feet from the West line of said Section 26.

CASE 1400:

Application of Gulf Oil Corporation for a dual completion. Applicant, in the above-styled cause, seeks an order authorizing the dual completion of its Naomi Keenum Well No. 2 located 660 feet from the South line and 1980 feet from the East line of Section 14, Township 21 South, Range 37 East, Lea County, New Mexico, in such a manner as to permit the production of oil from the Terry-Blinebry Oil Pool and to permit the production of gas from the Tubb Gas Pool through parallel strings of tubing.

CASE 1401:

Application of Gulf Oil Corporation for a dual completion. Applicant, in the above-styled cause, seeks an order authorizing the dual completion of its T. R. Andrews Well No. 3 located 1980 feet from the South and East lines of Section 32, Township 22 South, Range 38 East, Lea County, New Mexico, in such a manner as to permit the production of oil from an undesignated Paddock oil pool through tubing and to permit the production of gas from the Tubb Gas Pool through tubing up to the Paddock oil zone and thence through a crossover assembly into the casing-tubing annulus to the surface.

CASE 1402:

Application of Neville G. Penrose, Inc. for an exception to the No-Flare Order No. R-553 for an oil well in the Tubb Gas Pool. Applicant, in the above-styled cause, seeks an order granting an exception to No-Flare Order No. R-553 for its McCallister Well No. 1, located 660 feet from the North line and 660 feet from the West line of Section 7, Township 22 South, Range 38 East, Tubb Gas Pool, Lea County, New Mexico.

Case 1486

PETROLEUM AND ITS PRODUCTS

GULF OIL CORPORATION

P. O. DRAWER 1290 · FORT WORTH 1, TEXAS

E. HOSFORD
DIVISION PRODUCTION COORDINATOR

FORT WORTH
PRODUCTION DIVISION

February 6, 1958

Oil Conservation Commission
State of New Mexico
P. O. Box 871
Santa Fe, New Mexico

Re: Application to Dually Complete Gulf's Naomi Keenum Well No. 2 so as to Produce from the Terry-Blinebry Oil Pool and Tubb Gas Pool, Lea County

Gentlemen:

Gulf Oil Corporation respectfully submits application for permission to dually complete subject well, and requests that the Commission set this matter for examiner hearing at an early date.

The following facts are offered in support of this application:

(1) Gulf Oil Corporation's Naomi Keenum Well No. 2 is located 660 feet from the south line and 1980 feet from the east line of Section 14, T-21-S, R-37-E, Lea County, New Mexico. This well was originally completed in the Drinkard Oil Pool in March 1953; however, this pay was abandoned in October 1957, and the well plugged back to the Tubb pay where it was completed as a gas well in the Tubb Gas Pool. Based on recent completion of our Naomi Keenum Well No. 1 in the Terry-Blinebry Oil Pool, we now plan to complete subject well as an oil over gas dual completion in the Terry-Blinebry Oil Pool and Tubb Gas Pool.

(2) This well was drilled to a total depth of 7195 feet and 5½" casing set at 7193 feet and cemented with 695 sacks. A temperature survey indicated the top of the cement in the annulus to be 2970 feet. The plugged back total depth is 6700 feet. The Tubb zone is perforated from 6110 to 6284 feet and these perforations were treated with 12,000 gallons of acid and fractured with 30,000 gallons of sand-oil. After these treatments the well potentialed an estimated open flow of 8,000 MCF per day from the Tubb Gas Pool. If approval is obtained to dually complete this well, we anticipate treating the Blinebry oil zone perforations 5698 to 5800 feet with 1200 gallons of mud acid and 30,000 gallons of sand-oil frac.

(3) In dually completing this well, applicant proposes to utilize two packers and two independent strings of tubing. Because of a previous casing leak located at approximately 1645 feet, this method of completion will enable the formation pressure to be kept off the repaired casing leak. As will be noted on the attached diagrammatic sketch of the proposed installation, we plan to install a Baker Model "D" Packer at approximately 5879 feet which will separate the Tubb pay from the Blinebry pay and install a Baker Model "D" Packer No. 45-26 at 5668 feet to serve as the upper packer for the installation. A Baker Model "A" Parallel Anchor Flow Tube on 2" Hydrill "A" Tubing will be latched into the upper packer and will permit separation of production from each pay into individual tubing strings. The Blinebry oil production will be carried from the Parallel Anchor Flow Tube to the surface through 2" Hydrill "A" J-55 Tubing. The Tubb gas will flow from this point to the surface through 1½" NUJ-55 tubing to the surface. Pressure from the Tubb gas zone will be isolated below the lower packer and formation pressure from the Blinebry oil zone will be isolated between the two packers. There will be no pressure on the casing above the upper packer.

The manner and method of the proposed installation is mechanically feasible and practical and the granting of this oil over gas dual completion application is in the interest of conservation and the protection of correlative rights. Applicant will comply with all rules and regulations of the New Mexico Oil Conservation Commission to maintain separation of production from the two pays.

By copy of this letter of application, all offset operators are notified of the proposed dual completion.

Respectfully submitted,

GULF OIL CORPORATION

By E. Hosford
Division Production Coordinator

cc: Oil Conservation Commission
P. O. Box 2045
Hobbs, New Mexico

cc: Continental Oil Company
P. O. Box 427
Hobbs, New Mexico

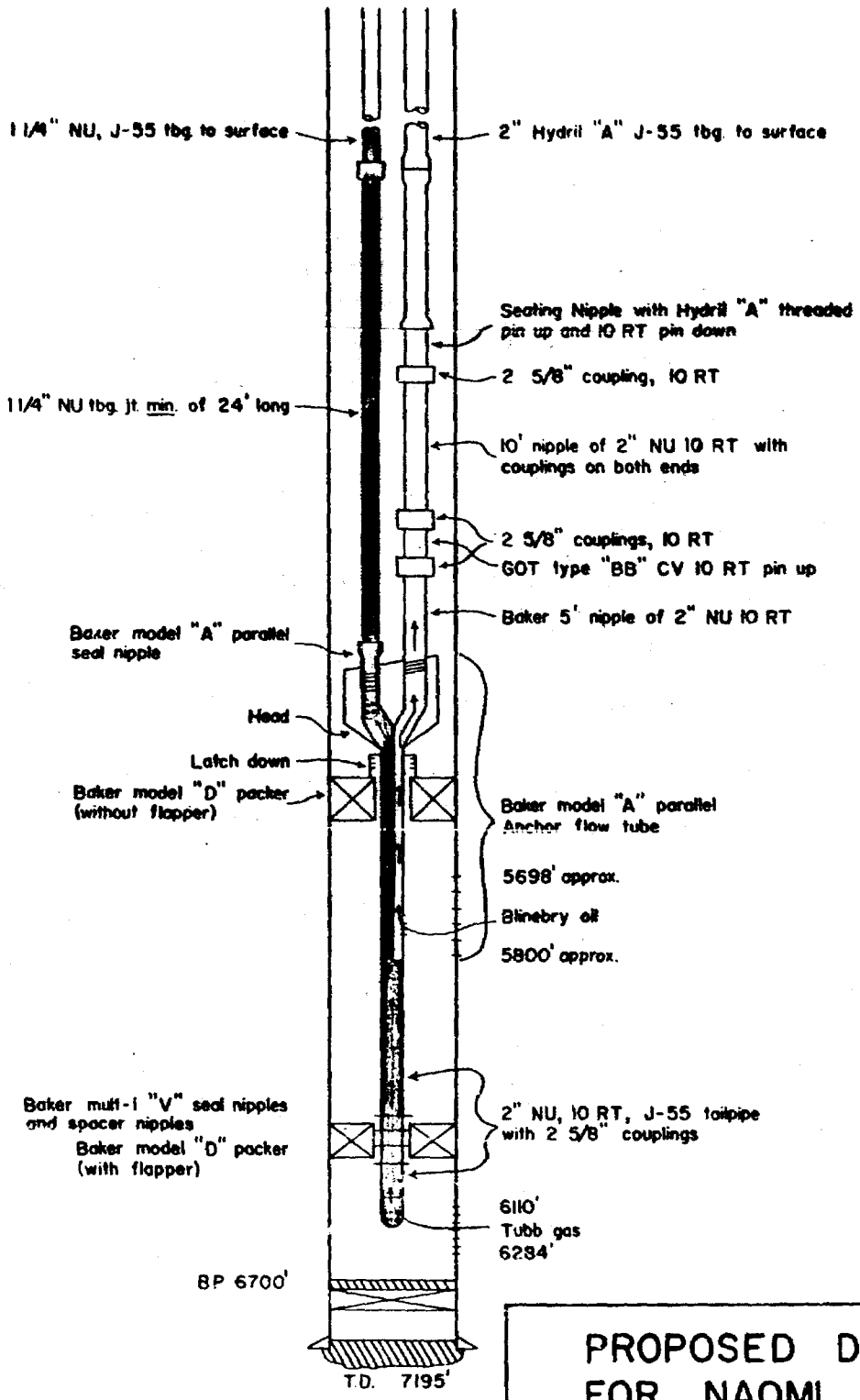
Magnolia Petroleum Company
P. O. Box 633
Midland, Texas

Markham, Cone and Redfern
209 Turner Drive
Hobbs, New Mexico

Shell Oil Company
P. O. Box 1957
Hobbs, New Mexico

Sinclair Oil and Gas Company
P. O. Box 1470
Hobbs, New Mexico

Tidewater Oil Company
P. O. Box 1404
Houston, Texas

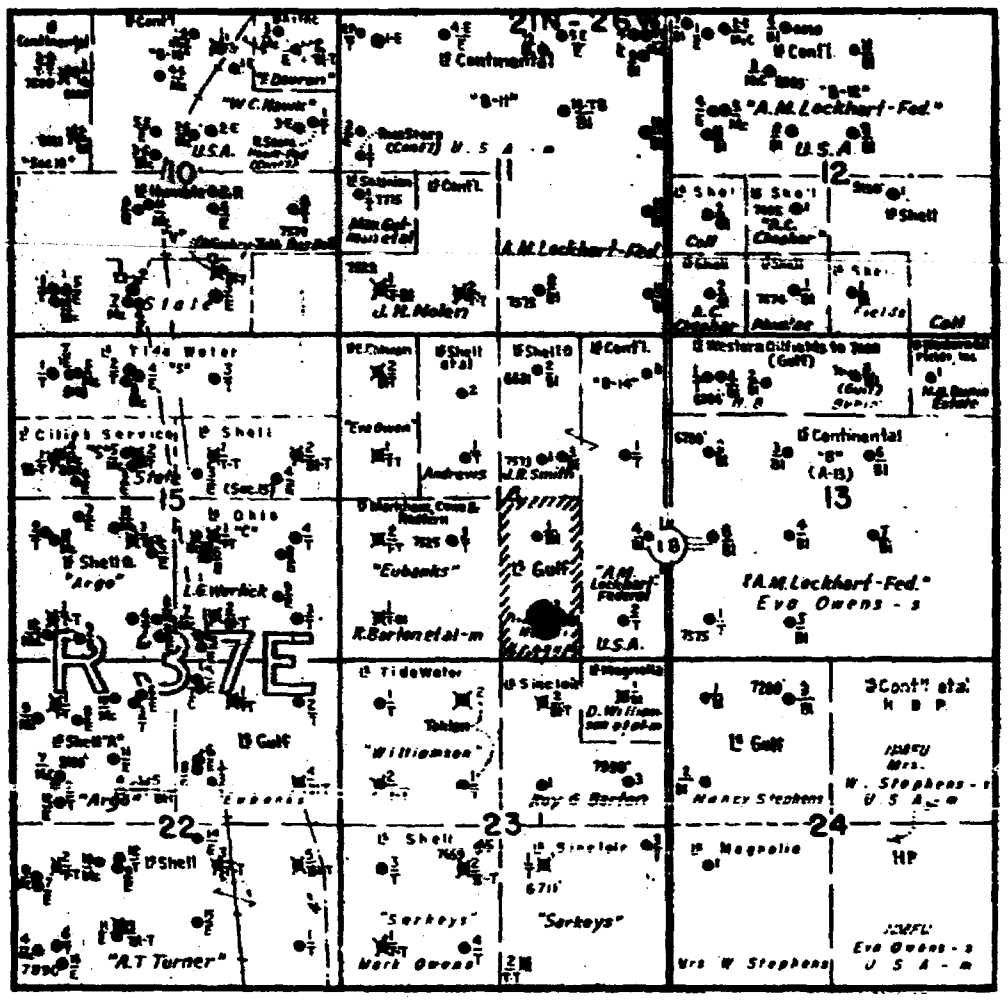


CASE NO. _____
EXHIBIT NO. _____

PROPOSED DUAL EQUIPMENT FOR NAOMI KEENUM NO. 2

TERRY-BLINEBRY OIL AND TUBB-GAS POOLS
LEA COUNTY, NEW MEXICO

GULF OIL CORPORATION JANUARY 29, 1958



GULF'S NAOMI KEENUM LEASE
LEA COUNTY, NEW MEXICO

Legend
Terry-Blinebry Oil Unit 40 Ac.
Tubb Gas Unit 80 Ac.
● Proposed Oil Over Gas Dual

GULF OIL CORPORATION SCALE 1" = 3000'

(Acc 1480)

NEW MEXICO
OIL CONSERVATION COMMISSION
P. O. Box 871
Santa Fe, New Mexico

Date February 12, 1958

Gulf Oil Corporation
P.O. Drawer 1290
Ft. Worth 1, Texas

ATTENTION: E. Hosford

Gentlemen:

Your application for the dual completion of the Gulf Naomi Keesum Well No. 2

dated February 6, 1958 has been received, and has been tentatively scheduled for hearing before an examiner on March 19, 1958.

A copy of the docket will be forwarded to you as soon as the matter is advertised

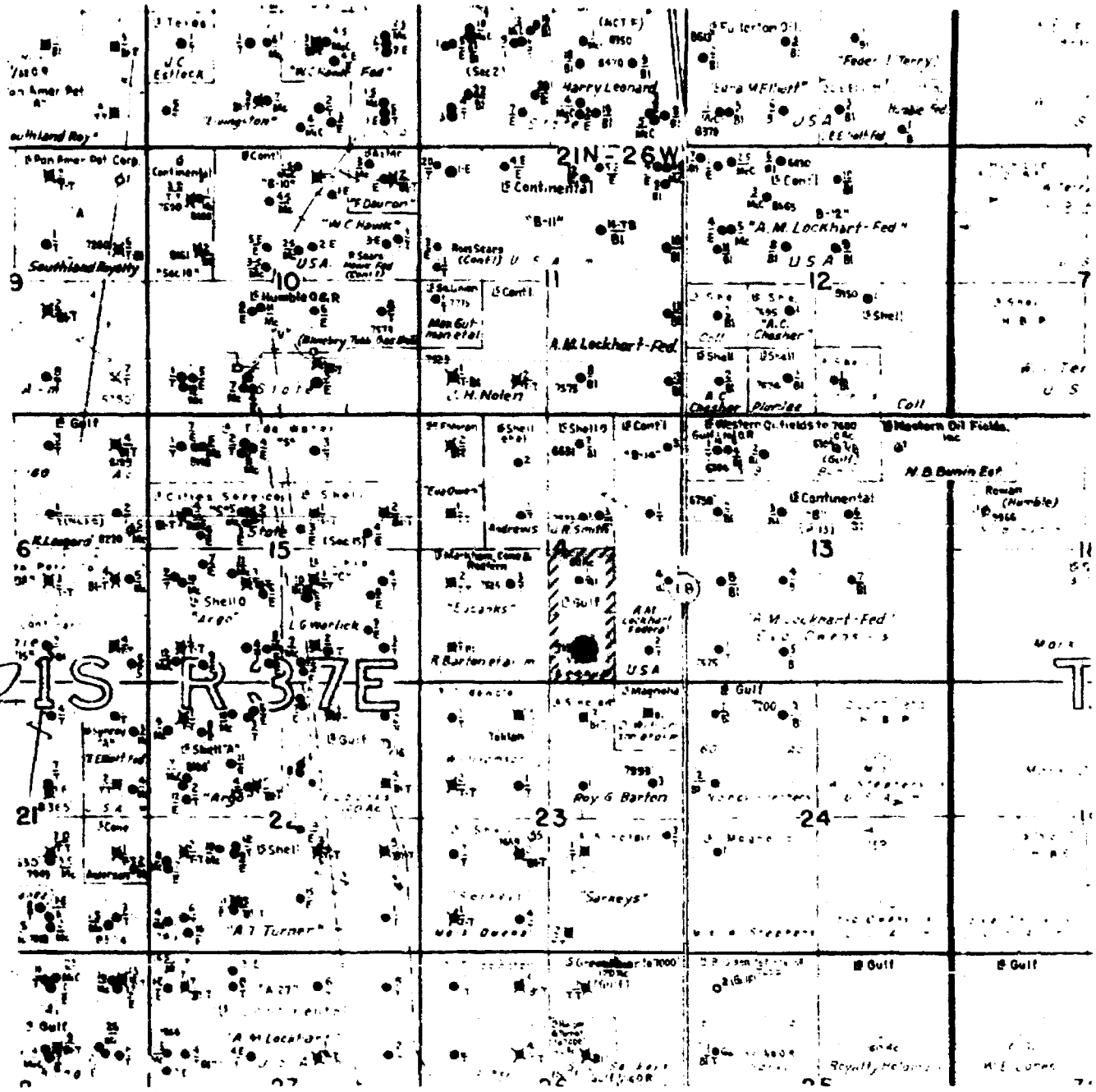
Very truly yours,

A. L. Porter, Jr.

A. L. PORTER, Jr.,
Secretary-Director

ga

Docket Mailed
3-6-58 BP



LEASE PLAT

NAOMI KEENUM

TERRY-BLINEBRY & TUBB GAS POOLS

LEA COUNTY, NEW MEXICO

- LEGEND -

Pertinent Gulf Lease

Pertinent Gulf Well

Gulf Oil Corporation March 19, 1958

Case No. 1400
Exhibit No. 1

Before Examiner Nutter
Oil Conservation Commission
Case No. 1400
Exhibit 1

ILLEGIBLE

FULL-OPENING PARALLEL-STRING HOOKUPS

and the Baker Retainer Production Packer

Parallel-string hookups overcome many of the major stumbling blocks previously encountered in dual-zone installations and in so doing approach the "two wells for the price of one" goal more closely than any other previous production system.
This Bulletin describes all current Baker Full-Opening, Parallel-String Hookups and contains additional information, such as Parallel-String Combined Diameter Charts for all probable combinations of tubing sizes and types, that will prove invaluable in planning any parallel-string installation.

Outline of Contents

Fig. 1
Baker Model "D"
Retainer Production Packer
Product No. 415-D

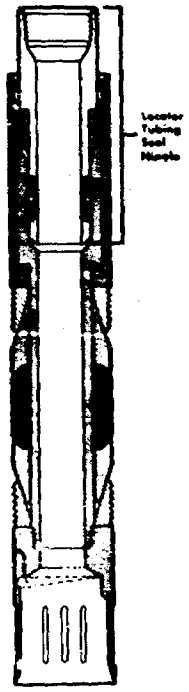


Fig. 2
Baker Model "DA"
Retainer Production Packer
Product No. 415-DA

FULL-OPENING, PARALLEL-STRING HOOKUPS AND THE BAKER RETAINER PRODUCTION PACKER

Introduction

The basic reason for a dual completion is one of greater economy. Though not entirely true, the *"two wells for the price of one"* theory, the resulting decrease in pay-out time and the shortage of casing are the prime reasons that dual completions exist. *Until the successful introduction of parallel-strings—all dual completions produced one zone through the annulus.* This practice, though far from ideal, was necessary in view of the equipment available at the time. All further developments, such as Baker Change-Over Flow Tubes and the Baker Selective Dual-Zone Production Hookup, were designed to alleviate this problem — and to make subsequent production and work-over costs low enough to realize the true advantage of a dual completion: two wells for the completion cost of one.

Parallel-string hookups overcome many of the major stumbling blocks previously encountered in dual-zone installations and in so doing approach the "two wells for the price of one" goal more closely than any other previous production system. As more experience is gained, and successful artificial lift systems developed, parallel-string dual-zone production installations will spread even into areas previously believed to be totally unsuited for dual-zone exploitation.

This Bulletin describes all current Baker Full-Opening, Parallel-String Hookups and includes information on accessories and operational methods that will be of great assistance in planning such hookups.

ADVANTAGES & DISADVANTAGES OF PARALLEL-STRINGS

Advantages:

(1) Permits each zone to be produced through an individual tubing string so that each zone will flow throughout a longer portion of producing life.

(2) Keeps production from the two zones isolated from each other and the casing. This is most desirable from a corrosion and bursting standpoint.

(3) Makes it possible to gas lift or pump either or both zones.

Not all of the Parallel-String Hookups to be described in this Bulletin incorporate all of these advantages. This will be brought out in the discussion of each of the individual hookups.

FEATURES COMMON TO MOST PARALLEL-STRING HOOKUPS

Most operators prefer to run and pull each tubing string independently. This does not mean that either string can be removed independently of the other, but means that one string can be either removed or run at a time provided a certain sequence is followed. Usually the short string (string producing the upper zone) must be removed before the long string (string producing the lower zone) can be removed and vice-versa when running-in. As another general requirement, most operators prefer to have the long string "full-opening" (tubing I.D.) in order to work-over the lower zone using permanent-type well completion methods.

BAKER FULL-OPENING, PARALLEL-STRING HOOKUPS

The hookups described in this Bulletin are designed to be installed as the initial hookup in a flowing well, a gas lift installation, or a pumping installation involving parallel-strings with two sets of rods. Information on parallel-string pumping installations with dual-zone pumps and a single set of rods is available on request, or from a Baker representative who is familiar with such hookups. It should also be pointed out that Parallel-String Hookups are possible in wells in which two Baker Retainer Production Packers have previously been installed, but that these hookups may not have the "full-opening" characteristic. Information on these hookups can be obtained from either the Central or Western Division Baker Sales Offices, provided literature is not available.

BAKER SINGLE-PACKER, FULL-OPENING, PARALLEL-STRING HOOKUPS

Short String Hanging Free

(Refer to Fig. 3)

Description:

This hookup permits production of the lower zone through a full-opening, long string that is packed off from the casing through a Baker Retainer Production Packer. The upper zone is produced through a short string. The short string is not packed off from the casing and hangs free above the Packer.

Applications:

(a) both zones flowing; (b) upper zone flowing, pumping lower zone.

Advantages:

1. *Full-opening (tubing I.D.) long string through Packer to lower zone.* Permits permanent-type well completion work-over methods on lower zone.

2. *Either string can be pulled or run independently of the other.* This is the only hookup that permits either string to be run or pulled independently of the other regardless of sequence. This, of course, is only possible if the couplings and Packer accessories of one string have clearance to pass the couplings and Packer accessories of the other. Certain combinations of tubing sizes permit this and others do not. As a further requirement it may be necessary to run the smaller bore Retainer Production Packers and their accessories. The Locator Tubing Seal Assembly used with the "small bore series" Packers contains a Locator Sub of reduced diameter that will permit the long string to be pulled past the couplings of the short string. Other sizes of Retainer Production Packers can be used but in these instances the long string must be run first and the short string pulled first.

Baker Equipment Required:

1. *Baker Retainer Production Packer, Product No. 415-D.*

2. *Baker Locator or Anchor Tubing Seal Assembly, Product Nos. 442-E2 or 443-E2.* The Locator Tubing Seal Assembly in Sizes 50 and 100 contains a Locator Seal Sub, in place of the Locator Sub, Upper Seal Sub, and Thread Seal that comprise an equivalent section of other sizes of this accessory. The smaller O.D. of the Locator Seal Sub permits the long string to be pulled past the short string.

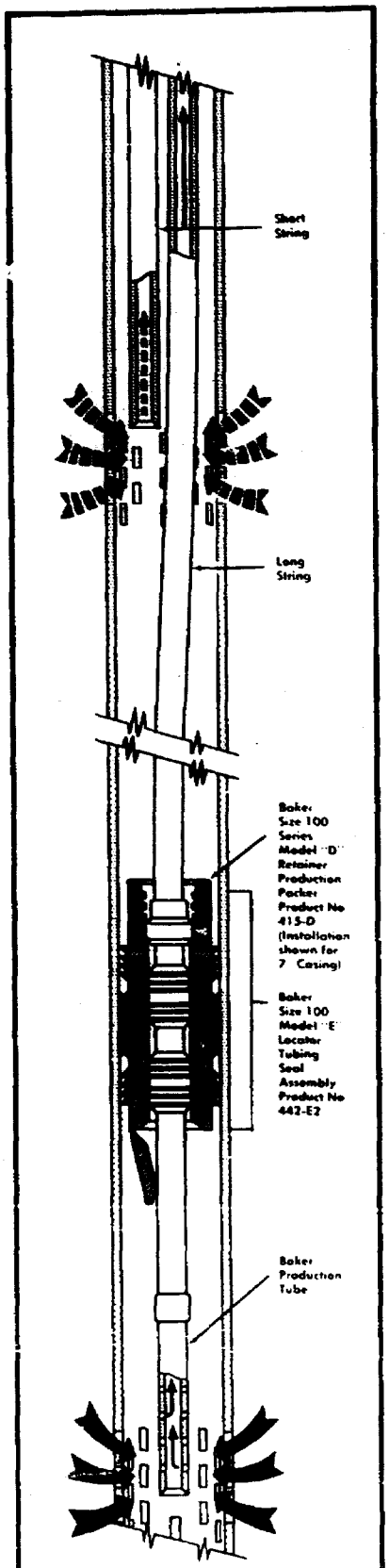


Fig. 3
Baker Single-Packer, Full-Opening Parallel-String Hookup, Short String Hanging Free

3. *Baker Full-Opening Production Tube, Product No. 457-D or 457-E.*

BAKER SINGLE-PACKER, FULL-OPENING, PARALLEL-STRING HOOKUPS

Short String Anchored

(Refer to Fig. 4)

Description:

This hookup permits production of the lower zone through a full-opening long string that is packed off from the casing through a Baker Retainer Production Packer. The upper zone is produced through a short string that is anchored to the long string above the Packer by means of a Parallel-String Anchor with Latching Sub. The short string is not packed off from the casing.

Applications:

(a) flow or pump upper zone; flow or pump lower zone.

Advantages:

1. *Full-opening (tubing I.D.) long string through Packer to lower zone.* Permits permanent-type well completion work-over methods on lower zone.

2. *Either string can be pulled or run separately.* However the long string must always be run first and the short string pulled first.

3. *Short string anchored.* Permits upper zone to be pumped through anchored short string.

Baker Equipment Required:

1. *Baker Model "D" Retainer Production Packer, Product No. 415-D.*

2. *Baker Anchor Tubing Seal Assembly, Product No. 443-E2.*

3. *Baker Full-Opening Production Tube, Product No. 457-D or 457-E.*

4. *Baker Parallel-String Anchor with Latching Sub, Product No. 699 (Refer to Figs. 5 and 6.)* The basic Anchor contains threaded connections for the Upper and Lower Long String Nipples, as well as Left-Hand Threads at its upper portion, into which the Anchor Ring of the Latching Sub "latches" to anchor the short string. Note that the top of the Parallel-String Anchor is machined to a funnel shape with an axis in line with the short string in order to guide the Latching Sub into the Left-Hand Threads. The Upper Long String Nipple with Tubing Thread Box Up and the Lower Long String Nipple with Tubing Thread Pin Down provide connections for the long string. The Short String Nipple with Tubing Thread Box Up provides connection for the short string.

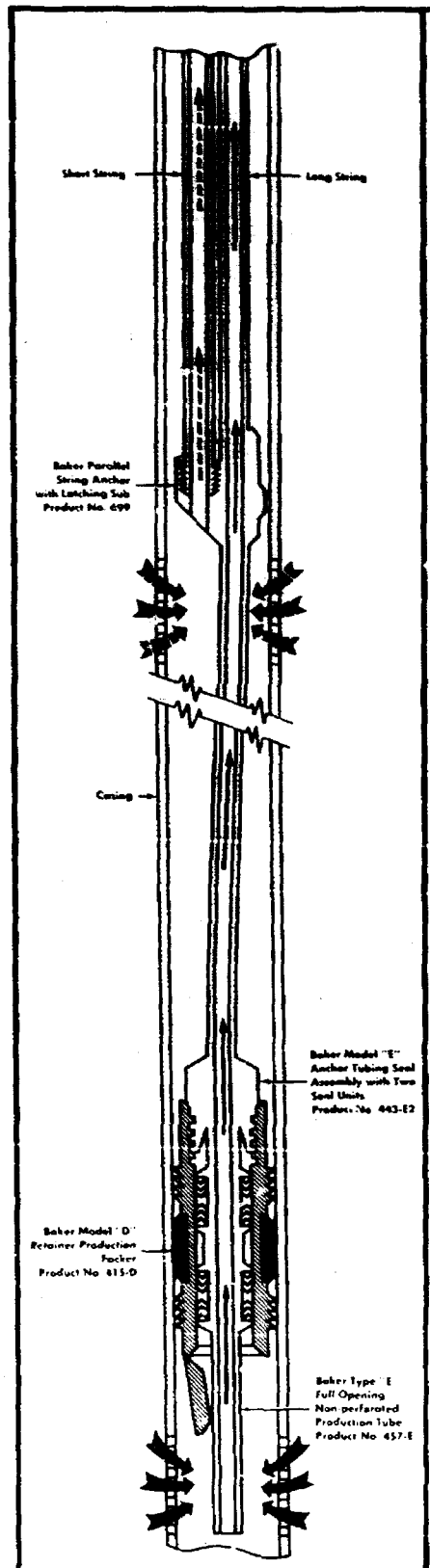


Fig. 4
Baker Single-Packer, Full-Opening Parallel-String Hookup, Short String Anchored

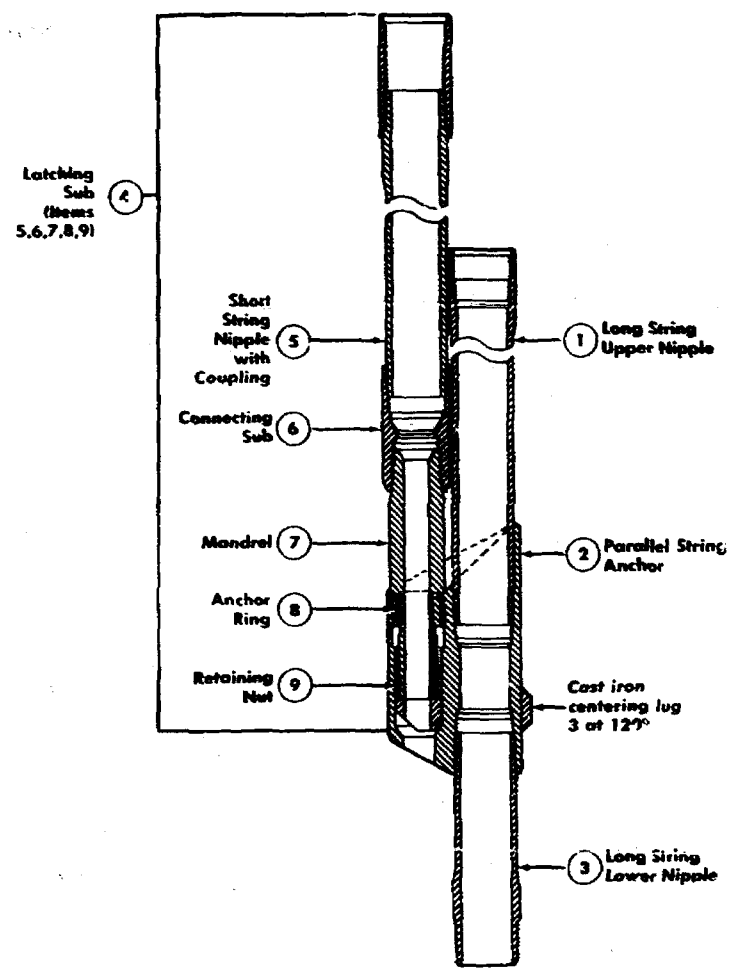


Fig. 5
Baker Parallel String Anchor with Latching Sub Product No. 699

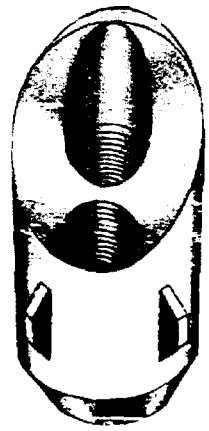


Fig. 6
Exterior view looking at top of Anchor

BAKER TWO-PACKER, FULL-OPENING, PARALLEL-STRING HOOKUP

(Refer to Fig. 7)

Description:

This hookup permits a dual completion with each zone confined to its individual tubing string—with a full-opening long string to the lower zone for the use of all permanent-type, well completion tools. Each string is packed off from the casing annulus. The hookup consists primarily of a Baker Model "DA" Retainer Production Packer (upper Packer), a Baker Model "D" Retainer Production Packer (lower Packer) and a Baker Full-Opening, Parallel Flow Tube (or Baker Full-Opening, Anchor Parallel Flow Tube). This Tube, which is made up into the long string, contains a Seal Nipple at its lower end that seats and seals off in the sealing bore of the Model "DA" Retainer Production Packer. The short string seals off in a sealing bore contained in upper end (Head) of the Flow Tube by means of either a Parallel Locator Seal Nipple, or a Parallel Anchor Seal Nipple. The long string extends down through the lower bore of the Model "DA" Packer to seal off in the bore of a regular Baker Retainer Production Packer through the use of a combination of conventional Baker Tubing Seal Nipples and Spacer Nipples.

Applications:

Two-zone production with (a) both zones flowing, high or low differential pressure; (b) upper zone pumping; lower zone flowing; (c) upper zone flowing; lower zone pumping; (d) both zones pumping.

Advantages:

1. Each zone completely isolated from the other as well as from the casing.
2. Full-opening long string to lower zone.
3. Either string can be pulled or run separately; however, the long string must always be run first and the short string pulled first.
4. Either or both strings can be held in tension if desired, by selecting accessories that incorporate the anchor or latching feature.

Baker Equipment Required:

1. *Baker Model "DA" Retainer Production Packer, Product No. 415-DA (upper Packer).*

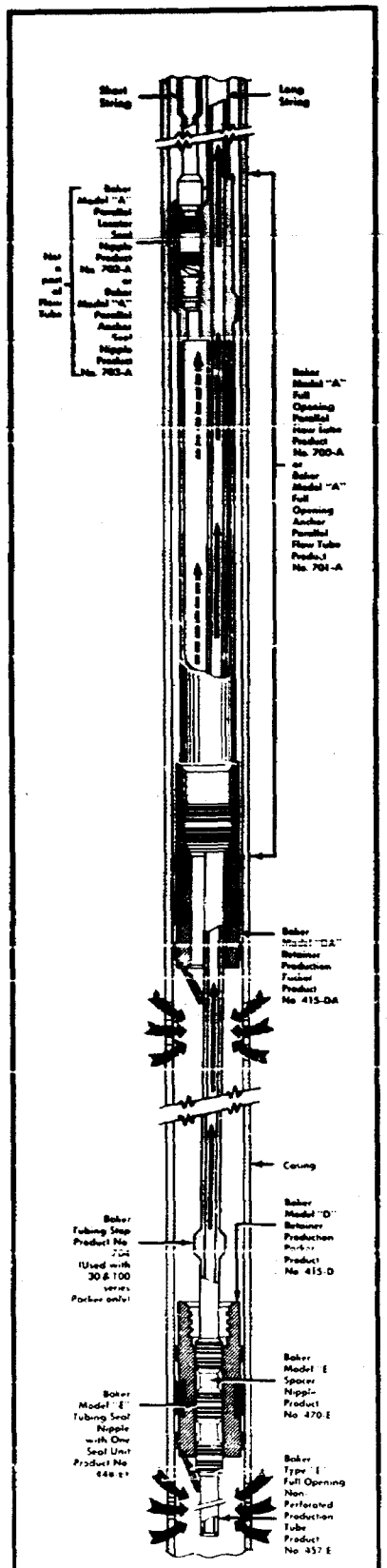


Fig. 7
Baker Two-Packer, Full-Opening Parallel-String Hookup

2. *Baker Model "D" Retainer Production Packer, Product No. 415-D (lower Packer).* The following combinations of these Packers can be run together:

Size Series DA Packer	can be run with	Size Series D Packer
40-DA		40 or 30*
80-DA		80 or 100*
190-DA		190 or 120*

*Choose size of lower Packer that requires the least set-down weight to retain the Seals in the bore of the Packer. If lower zone is the higher pressure, select the 30, 100 or 210 series (smaller bore) Packers. If the upper zone is the higher pressure, select the 40, 80 or 190 series Packers. The 30 and 100 series Packers might also be recommended because the Tubing Stop, which is used with these sizes of Packers, facilitates the recovery of the tubing below the top Packer should a fishing job be required. *(See Tubing Stop, Fig. 14.)*

3. *Baker Model "A" Full Opening, Parallel Flow Tube, Product No. 700-A. (Refer to Figs. 8 and 9.)*

The upper portion of this Tube contains a "Head" that is very similar in construction to the Parallel-String Anchor. The Head contains threaded connections for both the Upper and Lower Long String Nipples, as well as a Sealing Bore with Left-Hand Threads. This Sealing Bore in conjunction with the seals contained on either the Parallel Locator or Anchor Seal Nipple, which are made up on the bottom of the short string, provides a means of packing off the short string from the annulus above the upper Packer. Note that the top of the Head is machined to a funnel shape with an axis in line with the short string in order to guide Parallel Seal Nipples into the Sealing Bore. The Head is also available with a threaded connection in place of the sealing bore (Model "B" Full-Opening Parallel Flow Tube, Product No. 700-B) requiring that both strings be run together. A comparatively long extension of flush joint casing, which connects the Head to the Locator-Type Seal Nipple Sub Assembly, is required in order to accommodate the gradual offset necessary to direct the Long String Lower Nipple from its off center location in the Head to its near center position as it emerges into the lower bore of the "DA" Packer. This offset is gradual so that it will not interfere with tools that

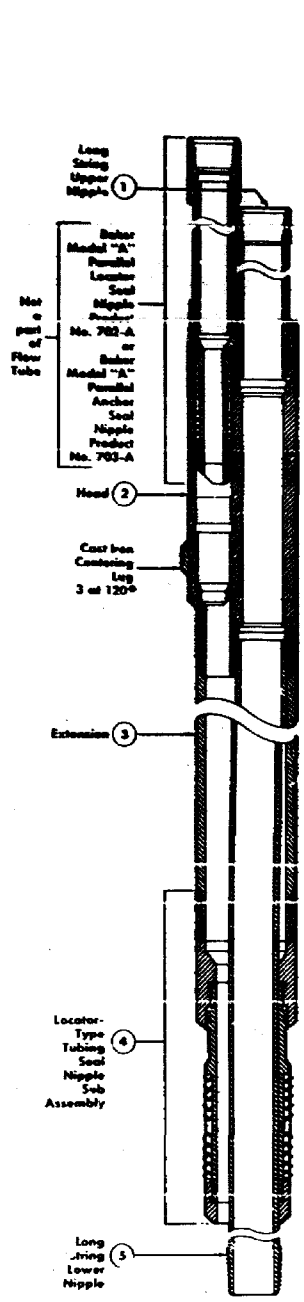


Fig. 8
Baker Model "A" Full-Opening Parallel Flow Tube Product No. 700-A

Fig. 9
Illustration of exterior Baker Model "A" Full-Opening, Parallel Flow Tube Product No. 700-A

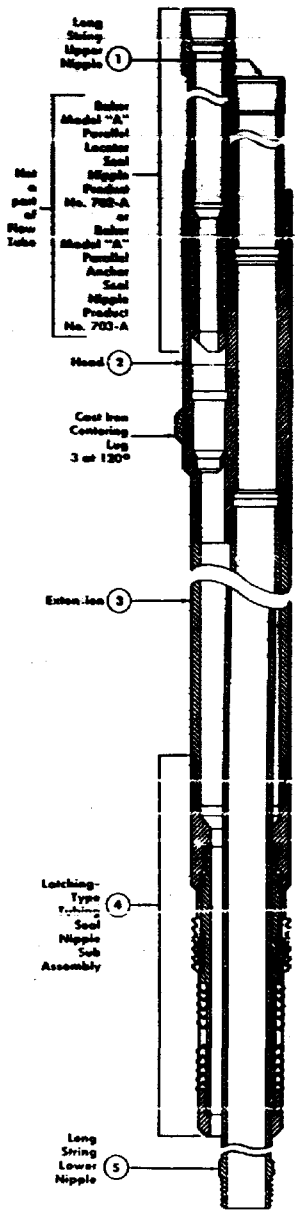


Fig. 10
Baker Model "A" Full-Opening Anchor Parallel Flow Tube Product No. 701-A

may be run through the tubing. This extension varies in length depending upon the size Model "DA" Packer with which it is run. No extension is required for Size 190DA.

4. *Baker Model "A" Full-Opening, Anchor Parallel Flow Tube, Product No. 701-A. (Refer to Fig. 10.)* This product is identical to Product No. 700-A described previously except that it contains a No-Left-Turn Latch for anchoring the long string to the upper Packer. This product is also available with a Head that contains a threaded connection in place of the Sealing Bore (Model "B" Full-Opening, Anchor Parallel Flow Tube, Product No. 701-B) requiring both strings to be run together.

5. *Baker Model "A" Parallel Locator Seal Nipple, Product No. 702-A. (Refer to Fig. 13.)* This product, which is made up on the bottom of the short string, is designed to seal off in the Sealing Bore contained in the Head of either of the Full-Opening Flow Tubes, thus packing off the short string from the casing above the upper Packer. Note that the Bottom Sub of this Nipple contains a bevel on one side to aid in guiding the short string into the Sealing Bore of the Flow Tube Head.

6. *Baker Model "A" Parallel Anchor Seal Nipple, Product No. 703-A. (Refer to Figs. 11 and 12.)* This product is similar to Product 702-A described above except that it contains an Anchor Ring for latching into the Left-Hand Threads located in the Sealing Bore of the Flow Tube Head. Its use makes it possible to anchor the short string if desired.

7. *Baker Tubing Stop, Product No. 704. (Refer to Fig. 14.)* This product is positioned immediately above the top Tubing Seal Nipple for the lower Packer. It does not normally contact the Packer but contains an extension of such a length that if it should contact the Packer, the Top Tubing Seal Nipples will be positioned in the bottom end of the packer bore. Because it contains a Sub of sufficient diameter to seat on the top end of the Retainer Production Packer it serves as a means of holding a Fishing Neck above the "DA" Packer should the tubing or Flow Tube become sanded in. In such cases, the long string can be cut in the Flow Tube just below the Head and the Flow Tube recovered. The Tubing Stop will then prevent the remaining portion of the long string from falling to bottom and provide an extension of the long string above the "DA" Packer that can be used as a fishing neck, to retrieve the remaining portion of the long string. The Tubing Stop is ONLY AVAILABLE IN SIZES 30 AND 100.

8. *Baker Tubing Seal Nipples, Product 448-E1.*

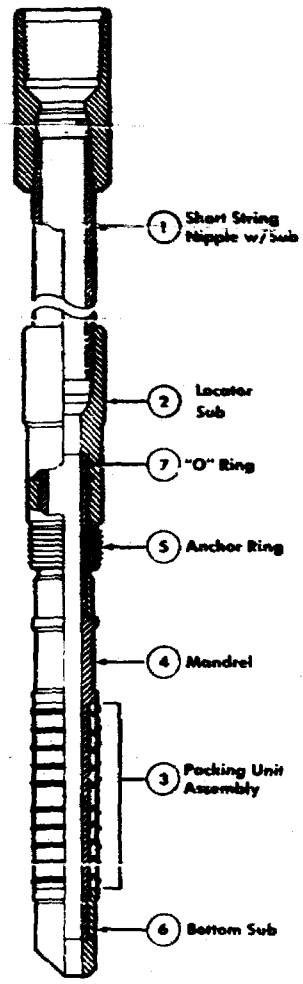


Fig. 11
Baker Model "A"
Parallel Anchor Seal Nipple
Product No. 703-A
Size No. 1.68

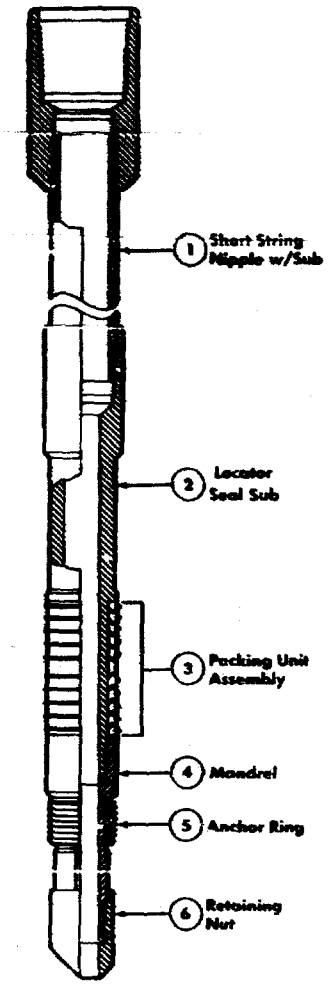


Fig. 12
Baker Model "A"
Parallel Anchor Seal Nipple
Product No. 703-A
Size Nos. 1.96 & 2.50

9. *Baker Spacer Nipples, Product No. 470-E.*

10. *Baker Full-Opening, Production Tubes, Product No. 457-D or 457-E.*

Conventional Baker Tubing Seal Nipples and Spacer Nipples are used to provide the necessary seal in the bore of the lower Packer. One of the Baker Full-Opening Production Tubes is run on the bottom of the long string.

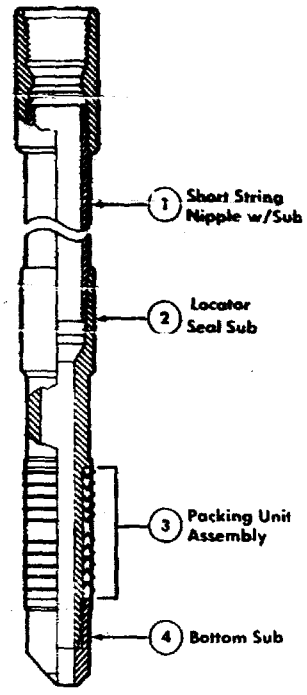


Fig. 13
Baker Model "A" Parallel Locator Seal Nipple Product No. 702-A

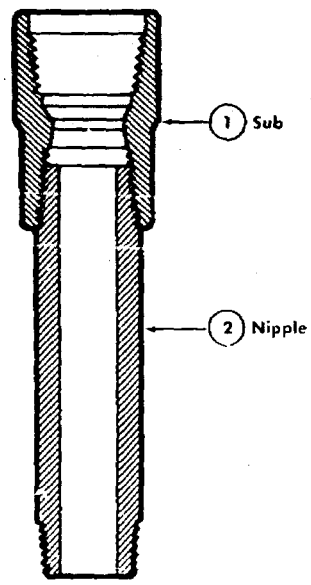


Fig. 14
Baker Tubing Stop Product No. 704

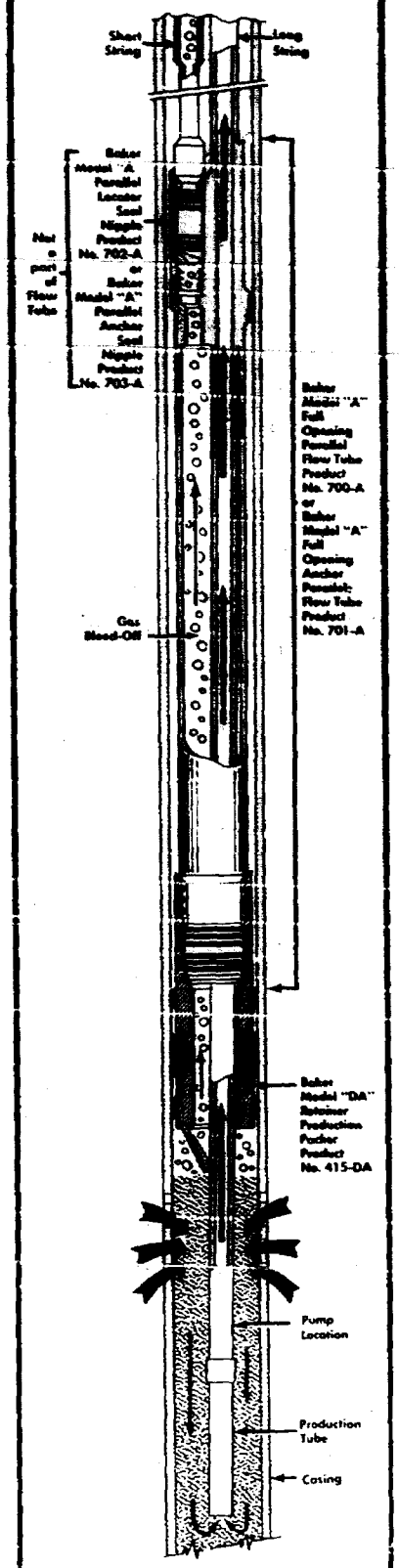


Fig. 15
Baker Single-Packer, Full-Opening Parallel Flow Tube Gas Bleed-Off Pumping Hookup

SINGLE-PACKER GAS BLEED-OFF HOOKUP

This hookup, which is illustrated in Fig. 15, provides a possible means of bleeding gas from a single-packer dual-zone installation in which the lower zone is being pumped. The installation is actually the upper portion of the Two-Packer, Full-Opening Parallel-String Hookup described previously and involves the use of a Baker Model "DA" Retainer Production Packer. This hookup uses the identical Baker Full-Opening, Parallel Flow Tube, Product No. 700-A or the Baker Full-Opening Anchor Parallel Flow Tube, Product 701-A as well as either of the Baker Parallel Seal Nipples, Product No. 702-A or Product No. 703-A which have been described previously.

SET-DOWN WEIGHT REQUIREMENTS FOR BAKER PARALLEL-STRING HOOKUPS

Set-down weight is required on both parallel strings of tubing, in Baker Full-Opening, Parallel-String Hookups involving the Baker Full-Opening, Parallel Flow Tube, Product No. 700-A and Baker Parallel Locator Seal Nipple, Product No. 702-A. If Parallel Locator Seal Nipple is used with Full-Opening, Anchor Parallel Flow Tube, only minimum set-down weight for short string is required. The amount of set-down weight required for a given installation is dependent upon the following factors: (1) the bottom-hole pressures of the two zones, (2) the hydrostatic pressure due to fluid in the well when the tubing strings are run and landed, (3) the hydrostatic pressure due to the fluid in the casing-to-tubing annulus when the well is producing, (4) certain physical dimensions of the components used in the hookup.

To simplify the calculation of set-down weight, a series of simple formulas have been derived for various probable combinations of upper and lower packers and Full-Opening, Parallel Flow Tube sizes. The derivation of the basic equations and their transformation into certain specific set-down weight formulas is shown in Fig. 16. Formulas for other sizes and combinations have not been included because of space limitations. To calculate the set-down weight for a particular size combination of components used, substitute the information obtainable from the well, such as bottom-hole pressure of both zones, hydrostatic pressure of fluid in the annulus when the well is producing.

DERIVATION OF FORMULAS FOR SET-DOWN WEIGHTS USING PARALLEL FLOW TUBE PRODUCT No. 700-A WITH SINGLE-PACKER OR TWO-PACKER HOOKUPS

The total set-down weight required on both strings of tubing in the fluid, which is in the well at the time the tubing is landed, is equal to the set-down weight required based on pressures existing after well completion less the buoyant force acting on both strings when the strings are run in and landed.

Total set-down weight on both strings for a Two-Packer Hookup is expressed in Equation 1:

Eq. 1
$$W_1=[P_1(A\text{-}B\text{-}G)-P_1(E\text{-}G)-P_1(F\text{-}B)+P_2(F\text{-}C)-H_A(A\text{-}B\text{-}D)+H_A(J\text{-}D)] -[H_M(A\text{-}B\text{-}G)-H_M(E\text{-}G)-H_M(F\text{-}B)+H_M(F\text{-}C)-H_M(A\text{-}B\text{-}D)+H_M(J\text{-}D)]$$
$$W_1=[P_1(A\text{-}E\text{-}F)+P_2(F\text{-}C)-H_A(A\text{-}B\text{-}J)]-[H_M(B\text{-}C+J\text{-}E)]$$

The minimum set-down weight on the short string for Single-Packer or Two-Packer Hookups is expressed in Equation 2:

Eq. 2
$$W_2=[P_1(D\text{-}G)-P_1(E\text{-}G)+H_A(J\text{-}D)]-[H_M(D\text{-}G)-H_M(E\text{-}G)+H_M(J\text{-}D)]$$
$$W_2=[P_1(D\text{-}E)+H_A(J\text{-}D)]-[H_M(J\text{-}E)]$$

For Single-Packer Hookups $P_1=P_2$. Substituting $P_1=P_2$ in Equation 1 results in Equation 3 expressing total set-down weight for Single-Packer Hookups:

Eq. 3
$$W_3=[P_1(A\text{-}E\text{-}F)+P_1(F\text{-}C)-H_A(A\text{-}B\text{-}J)]-[H_M(B\text{-}C+J\text{-}E)]$$
$$W_3=[P_1(A\text{-}E\text{-}C)-H_A(A\text{-}B\text{-}J)]-[H_M(B\text{-}C+J\text{-}E)]$$

Specific Formulas for a given combination of hookup components can be obtained by substituting the effective areas, as shown below:

Casing Size	Size Tubing Strings: Long	Size Tubing Strings: Short	Set-Down Weight Formulas*
† 5½"	1.900	1.900	$W_1=1.5P_1+2.8P_2-2.6H_A-1.6H_M+5000SF$
			$W_2=0.2P_1+0.6H_A-0.8H_M+2000SF$
5½"	1.900	1.900	$W_1=0.6P_1+3.6P_2-2.6H_A-1.6H_M+5000SF$
			$W_2=0.2P_1+0.6H_A-0.8H_M+2000SF$
† 7"	2⅜	2⅜	$W_1=3.8P_1+2.5P_2-3.7H_A-2.6H_M+8000SF$
			$W_2=-0.1P_1+1.4H_A-1.3H_M+4000SF$
7"	2⅜	2⅜	$W_1=1.1P_1+5.2P_2-3.7H_A-2.6H_M+8000SF$
			$W_2=-0.1P_1-1.4H_A-1.3H_M+4000SF$
† 9⅝"	2⅜	2⅜	$W_1=15.3P_1+3.6P_2-15.3H_A-3.6H_M+10,000SF$
			$W_2=0.2P_1+1.6H_A-1.8H_M+5000SF$
9⅝"	2⅜	2⅜	$W_1=5.9P_1+13.0P_2-15.3H_A-3.6H_M+10,000SF$
			$W_2=0.2P_1+1.6H_A-1.8H_M+5000SF$

*Formulas are for set-down weights to be applied when the tubing is landed. Formulas take into account buoyancy of the strings. The last term of each formula represents the safety factor; i.e., 5000 SF, 2000 SF, etc.

†Indicates formulas to be used when smaller bore lower Packer is run.

DEFINITION OF TERMS

W_1=Total set-down weight on both strings Two-Packer Hookup
W_2=Minimum set-down weight on short string with either Two-Packer or Single-Packer Hookups
W_3=Total set-down weight on both strings Single-Packer Hookup
P_1=Bottom-hole pressure of top zone
P_2=Bottom-hole pressure of lower zone
H_A=Hydrostatic pressure of fluid in annulus when well has been completed
H_M=Hydrostatic pressure of fluid in well when tubing strings are run and landed
A=Area of "DA" Packer bore
B=Area of OD of long string
C=Area of ID of long string
D=Area of ID of Flow Tube Receptacle
E=Area of ID of short string
F=Area of "D" Packer bore
G=Area of ID of Seal Nipple
J=Area of OD of short string

Fig. 16

Note that minimum safety factors have been added and are included in each formula. The buoyant effect of the mud in the hole on the tubing strings tends to make the tubing weigh less than it actually will when the well is brought on production. This effect has been taken into account in the formulas, but it makes the set-down weights as calculated from the formulas appear less than might be expected. Actually the weight on the Packer will increase as the well is brought on production. This increase is indicated by the H_m factor. It should be understood that if the Full-Opening, Anchor Parallel Flow Tube, Product No. 701-A is used, there is no need for calculating the set-down weight of both strings. If the short string is not anchored to the Flow Tube, the minimum set-down weight should be calculated for this string.

How to Plan Baker Parallel-String Hookups

The starting point for planning any parallel-string hookup is obviously the determination of the type of available hookup that will best fulfill the desired production requirement. The selection of the type of hookup (single-packer or two-packer) will depend upon the characteristics of the zones to be produced with respect to the most efficient and economical means of recovery (flowing, pumping, gas lift). The next step is the selection from available supply, of the sizes and types of tubing desired for the long and short strings. A chart listing the sizes and specifications of most types of tubing is shown in Fig. 19. Along with the selection of the long and short string tubing, the combined diameter of the long and short string tubing joints with respect to the I.D. of the casing through which the strings are to be run must be considered. The parallel-string diameter charts (Fig. 17 and 18) list the combined joint diameters of various combinations of tubing sizes and types. This combined diameter, when compared with the I.D. of the casing size to be run, will permit the selection of a practical hookup. This information combined with the type of hookup desired (single-packer, two-packer, etc.) along with the production methods to be used (pumping, flowing) is all that is required to order any Baker Parallel-String Hookup. Any qualified Baker Field Engineer can then order exactly the right type and size of the many accessories and Packers available to fit the exacting requirements deemed necessary for any specific installation.

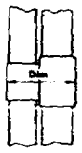
Fig. 17

COMBINED PARALLEL-STRING DIAMETERS, Parallel-Strings Run Separately

TUBING O.D.	1.050 E.U.	1.315 E.U.	1.315 "CS" HYDRIL	1.660 "CS" HYDRIL	1.660 E.U.	1.900 "CS" HYDRIL	1.900 N.U.	1.900 E.U.	2.062 "CS" HYDRIL	2.375 "CS" HYDRIL	2.375 "XL" SPANG	2.375 N.U.	2.375 E.U.	2.875 "CS" HYDRIL	2.875 "XL" SPANG	2.875 N.U.	2.875 E.U.	3.500 "CS" HYDRIL	3.500 "XL" SPANG	3.500 N.U.	3.500 E.U.
1.050 E.U.	3.320																				
1.315 E.U.	3.560	3.800																			
1.315 "CS" HYDRIL	3.212	3.452	3.104																		
1.660 "CS" HYDRIL	3.543	3.783	3.435	3.766																	
1.660 E.U.	3.860	4.100	3.752	4.083	4.400																
1.900 "CS" HYDRIL	3.773	4.013	3.665	3.996	4.313	4.226															
1.900 N.U.	3.860	4.100	3.752	4.083	4.400	4.313	4.400														
1.900 E.U.	4.160	4.400	4.052	4.383	4.700	4.613	4.700	5.000													
2.062 "CS" HYDRIL	3.990	4.230	3.882	4.213	4.530	4.443	4.530	4.830	4.660												
2.375 "CS" HYDRIL	4.362	4.602	4.254	4.585	4.902	4.815	1.902	5.202	5.032	5.404											
2.375 "XL" SPANG	4.660	4.900	4.552	4.883	5.200	5.113	5.200	5.500	5.330	5.702	6.000										
2.375 N.U.	4.535	4.775	4.427	4.758	5.075	4.988	5.075	5.375	5.205	5.577	5.875	5.750									
2.375 E.U.	4.723	4.963	4.615	4.946	5.263	5.176	5.263	5.563	5.393	5.765	6.063	5.938	6.126								
2.875 "CS" HYDRIL	4.880	5.120	4.772	5.103	5.420	5.333	5.420	5.720	5.550	5.922	6.220	6.095	6.283	6.440							
2.875 "XL" SPANG	5.160	5.400	5.052	5.383	5.700	5.613	5.700	6.000	5.830	6.202	6.500	6.375	6.563	6.720	7.000						
2.875 N.U.	5.160	5.400	5.052	5.383	5.700	5.613	5.700	6.000	5.830	6.202	6.500	6.375	6.563	6.720	7.000	7.000					
2.875 E.U.	5.328	5.568	5.220	5.551	5.868	5.781	5.868	6.168	5.998	6.370	6.668	6.543	6.731	6.888	7.168	7.168	7.336				
3.500 "CS" HYDRIL	5.524	5.764	5.416	5.747	6.064	5.977	6.064	6.364	6.194	6.566	6.864	6.739	6.927	7.084	7.364	7.364	7.532	7.728			
3.500 "XL" SPANG	5.910	6.150	5.802	6.133	6.450	6.362	6.450	6.750	6.580	6.952	7.250	7.125	7.313	7.470	7.750	7.750	7.918	8.114	8.500		
3.500 N.U.	5.910	6.150	5.802	6.133	6.450	6.363	6.450	6.750	6.580	6.952	7.250	7.125	7.313	7.470	7.750	7.750	7.918	8.114	8.500	8.500	
3.500 E.U.	6.160	6.400	6.052	6.383	6.700	6.613	6.700	7.000	6.830	7.202	7.500	7.375	7.563	7.720	8.000	8.000	8.168	8.364	8.750	8.750	9.000

The Dimensions listed in this Chart are the exact minimum combined O.D. as shown in the illustration.

CLEARANCE MUST BE ADDED TO THESE DIMENSIONS.



It is recommended that the long string of tubing above the Flow Tube have joints other than couplings. It is possible that the standard couplings would cause damage to the seals on the Parallel Seal Nipple or threads of Latching Sub when the short string is being run into the well. If threaded and coupled tubing is run, it is recommended that all long-string couplings be beveled.

Fig. 18

COMBINED PARALLEL-STRING DIAMETERS, Parallel-Strings Run Simultaneously; Couplings Staggered

TUBING O.D.	1.050 E.U.	1.315 E.U.	1.315 "CS" HYDRIL	1.660 "CS" HYDRIL	1.660 E.U.	1.900 "CS" HYDRIL	1.900 N.U.	1.900 E.U.	2.062 "CS" HYDRIL	2.375 "CS" HYDRIL	2.375 "XL" SPANG	2.375 N.U.	2.375 E.U.	2.875 "CS" HYDRIL	2.875 "XL" SPANG	2.875 N.U.	2.875 E.U.	3.500 "CS" HYDRIL	3.500 "XL" SPANG	3.500 N.U.	3.500 E.U.
1.050 E.U.	3.015																				
1.315 E.U.	3.267	3.508																			
1.315 "CS" HYDRIL	3.093	3.333	2.985																		
1.660 "CS" HYDRIL	3.432	3.672	3.324	3.655																	
1.660 E.U.	3.580	3.820	3.633	3.972	4.139																
1.900 "CS" HYDRIL	3.667	3.907	3.569	3.890	4.207	4.126															
1.900 N.U.	3.710	3.950	3.633	3.972	4.250	4.207	4.250														
1.900 E.U.	3.860	4.108	3.933	4.272	4.430	4.507	4.550	4.700													
2.062 "CS" HYDRIL	3.856	4.096	3.763	4.103	4.396	4.225	4.396	4.696	4.526												
2.375 "CS" HYDRIL	4.199	4.439	4.135	4.474	4.739	4.709	4.752	5.039	4.898	5.241											
2.375 "XL" SPANG	4.355	4.606	4.433	4.772	4.938	5.097	5.050	5.200	5.196	5.539	5.688										
2.375 N.U.	4.285	4.525	4.308	4.647	4.825	4.882	4.925	5.125	5.071	5.414	5.625	5.500									
2.375 E.U.	4.418	4.671	4.496	4.835	4.983	5.070	5.113	5.263	5.259	5.602	5.751	5.688	5.782								
2.875 "CS" HYDRIL	4.708	4.94*	[illegible]	4.982	5.248	5.227	5.270	5.548	5.416	5.759	6.048	5.923	6.111	6.268							
2.875 "XL" SPANG	4.855	5.108	4.933	5.272	5.430	5.507	5.550	5.700	5.696	6.039	6.188	6.125	6.251	6.548	6.688						
2.875 N.U.	4.855	5.108	4.933	5.272	5.430	5.507	5.550	5.700	5.696	6.039	6.188	6.125	6.251	6.548	6.688	6.688					
2.875 E.U.	5.023	5.276	5.101	5.440	5.598	5.675	5.718	5.868	5.864	6.207	6.356	6.293	6.387	6.716	6.856	6.856	6.948				
3.500 "CS" HYDRIL	5.342	5.582	5.297	5.636	5.882	5.871	5.914	6.182	6.060	6.403	6.682	6.557	6.745	6.912	7.182	7.182	7.350	7.546			
3.500 "XL" SPANG	5.605	5.858	5.683	6.022	6.180	6.257	6.300	6.450	6.446	6.789	6.938	6.875	6.960	7.298	7.438	7.438	7.543	7.932	8.125		
3.500 N.U.	5.605	5.858	5.683	6.022	6.180	6.257	6.300	6.450	6.446	6.789	6.938	6.87[illegible]	6.969	7.298	7.438	7.438	7.543	7.932	8.125	8.125	
3.500 E.U.	5.855	6.108	5.933	6.272	6.430	6.507	6.550	6.700	6.696	7.039	7.188	7.125	7.219	7.548	7.688	7.688	7.772	8.182	8.375	8.375	8.500

The Dimensions listed in this Chart are the exact minimum combined O.D. as shown in the illustration.

CLEARANCE MUST BE ADDED TO THESE DIMENSIONS

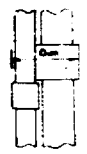


Fig. 19

TUBING DIMENSIONAL DATA

Tubing O.D.	Type Thd.	Tubing Nom.	Wt. Per Ft.	I.D.	Drift Dia.	Inside Dia. Sq. in Area	Joint I.D.	Cplg. O.D. or Joint O.D.	Special Joint O.D.
1.050	E.U.	¾	1.20	.824	.730	.533		1.660	
1.315	E.U.	1	1.80	1.049	.955	.864		1.900	
1.315	Hydril "CS"	1	1.80	1.049	.955	.864	.970	1.552	
1.660	Hydril "CS"	1¼	2.40	1.380	1.286	1.496	1.301	1.883	
1.660	E.U.	1¼	2.40	1.380	1.286	1.496		2.200	
1.900	Hydril "CS"	1½	2.90	1.610	1.516	2.036	1.531	2.113	
1.900	N.U.	1½	2.75	1.610	1.516	2.036		2.200	
1.900	E.U.	1½	2.90	1.610	1.516	2.036		2.500	
2.062*	Hydril "CS"	...	3.4	1.750	1.657	2.405	1.700	2.330	
2.375	Hydril "CS"	2	4.70	1.995	1.901	3.126	1.945	2.702	2.630
2.375	Spang "XL"	2	4.70	1.995	1.901	3.126	**	3.000	
2.375	N.U.	2	4.60	1.995	1.901	3.126		2.875	
2.375	E.U.	2	4.70	1.995	1.901	3.126		3.063	
2.375	E.U.	2	5.95	1.867	1.773	2.737		3.063***	
2.875	Hydril "CS"	2½	6.50	2.441	2.347	4.676	2.370	3.220	3.155
2.875	Spang "XL"	2½	6.50	2.441	2.347	4.676	**	3.500	
2.875	N.U.	2½	6.40	2.441	2.347	4.676		3.500	
2.875	N.U.	2½	8.60	2.259	2.165	4.008		3.500	
2.875	E.U.	2½	6.50	2.441	2.347	4.676		3.668	
2.875	E.U.	2½	8.70	2.259	2.165	4.008		3.668	
3.500	Hydril "CS"	3	9.30	2.992	2.867	7.031	2.921	3.864	3.805
3.500	Spang "XL"	3	9.30	2.992	2.867	7.031	**	4.250	
3.500	N.U.	3	9.20	2.992	2.867	7.031		4.250	
3.500	N.U.	3	12.70	2.750	2.625	5.940		4.250	
3.500	E.U.	3	9.30	2.992	2.867	7.031		4.500	
3.500	E.U.	3	12.95	2.750	2.625	5.940		4.500	
4.000	Hydril "CS"	3½	11.00	3.476	3.351		3.395	4.343	4.315
4.000	N.U.	3½	9.50	3.548	3.423			4.750	
4.000	E.U.	3½	11.00	3.476	3.351			5.000	
4.500	Hydril "CS"	4	12.75	3.958	3.833		3.865	4.855	4.825
4.500	N.U.	4	12.60	3.958	3.833			5.200	
4.500	E.U.	4	12.75	3.958	3.833			5.563	

*Non A.P.I. Tubing. This size is being developed by Hydril.

**Joint I.D. not published but is larger than drfit diameter.

***N-80 Couplings are sometimes turned to 2.910 by the operators. This dia. is listed for reference and does not constitute a recommendation by Baker Oil Tools, Inc.

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