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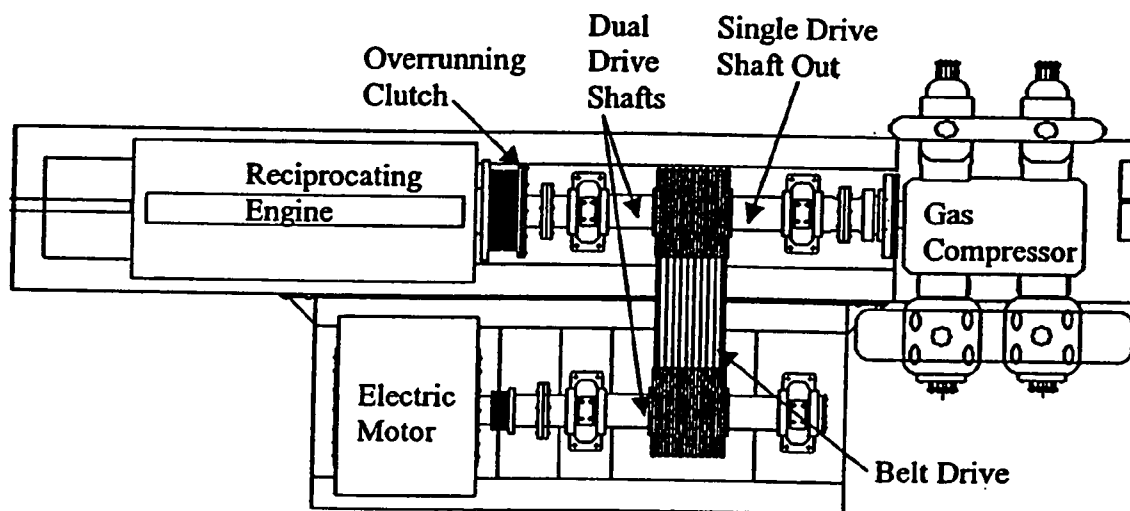
(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0196298 A1**
Manning (43) **Pub. Date: Sep. 8, 2005**(54) **GAS COMPRESSOR DUAL DRIVE
MECHANISM****Publication Classification**(76) Inventor: **John B. Manning**, Lakeland, FL (US)(51) **Int. Cl.⁷** **F04B 17/00; F04B 35/04**(52) **U.S. Cl.** **417/364; 417/410.1**

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BURNS & LEVINSON LLP**1030 15TH STREET NW, SUITE 300****WASHINGTON, DC 20005-1501 (US)**(57) **ABSTRACT**(21) Appl. No.: **11/073,146**(22) Filed: **Mar. 4, 2005****Related U.S. Application Data**

(60) Provisional application No. 60/550,812, filed on Mar. 5, 2004.

A dual drive mechanism for a gas compressor includes a pulley and belt drive system to provide power to a gas compressor using either an electric motor or a reciprocating engine. The source of the power can be chosen by the operator of the system depending on a number of variables, including the cost of electric power.

Dual Drive Mechanism

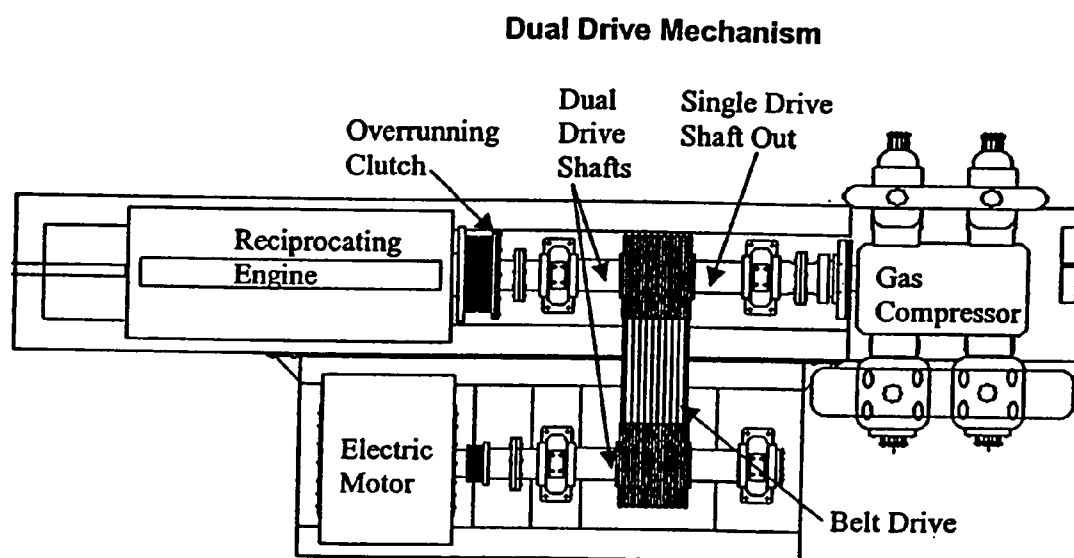


Fig 1

FIG. 2

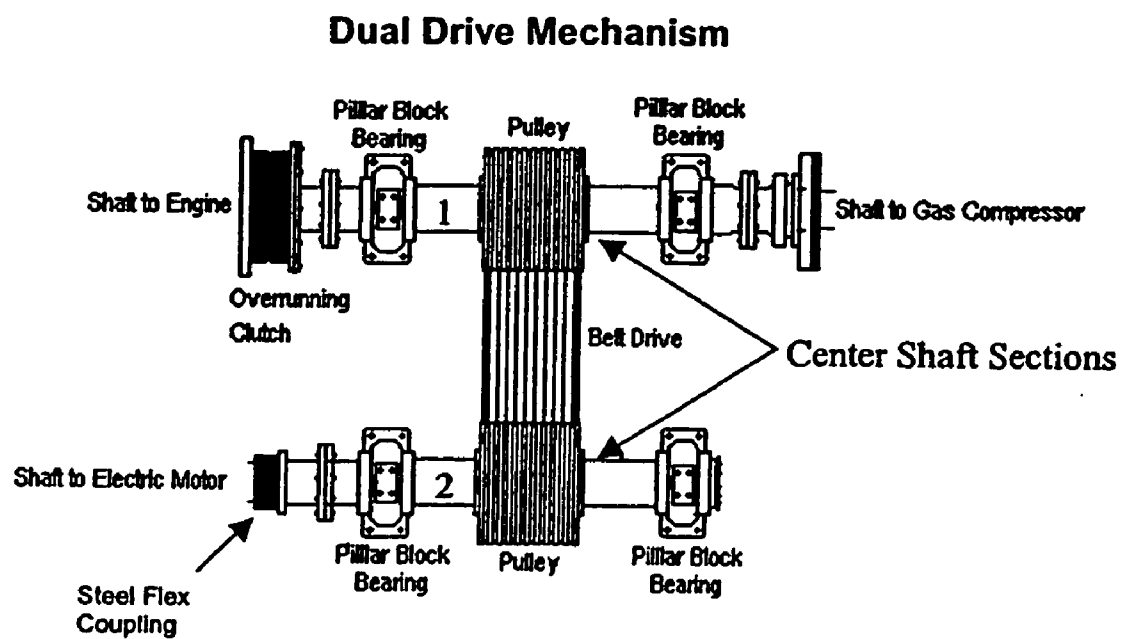
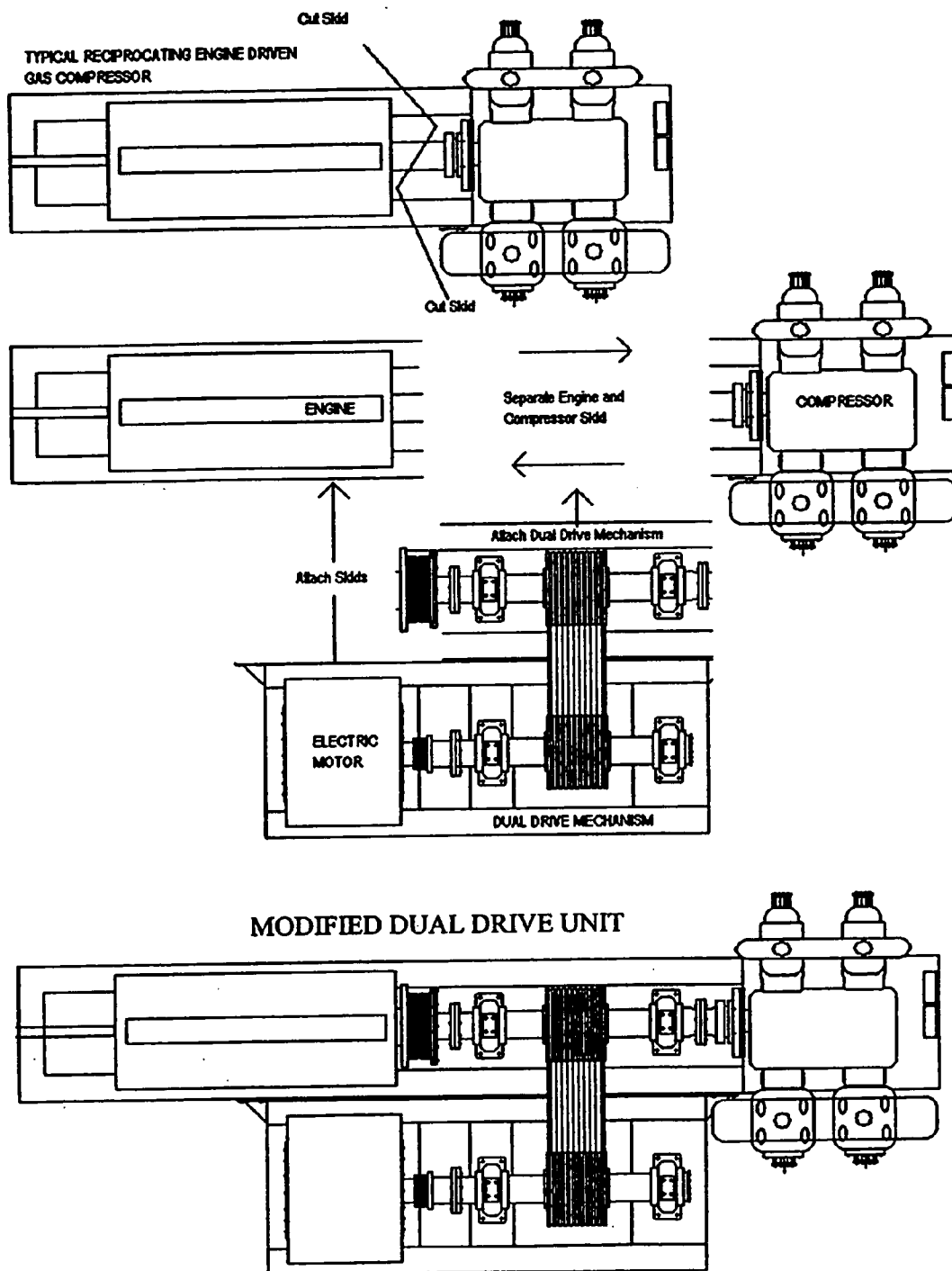


FIGURE 3



GAS COMPRESSOR DUAL DRIVE MECHANISM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority benefit from provisional U.S. application Ser. No. 60/550,812 filed Mar. 5, 2004, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The invention is related to the natural gas energy industry and more particularly to the field of mechanical drive systems for gas compressors.

BACKGROUND OF THE INVENTION

[0003] In the natural gas gathering industry, there have been two basic gas compressor units available in the 1000 to 4000 hp range. One is an electric driven gas compressor and the other is a reciprocating engine driven gas compressor. Electric driven gas compressors in this class range have been predominantly utilized in the offshore drilling industry and in isolated cases for landside use. Electric driven gas compressors are particularly useful in cutting down on polluting emissions and tend to be easier to maintain.

[0004] Although an electric driven gas compressor offers more favorable maintenance features, the fluctuating and often high price of electricity have prevented electric driven compressors from being more widely utilized. For example, the majority of electric utilities in the US consider the availability of extra capacity when establishing an electricity rate to larger industrial users of electricity. Larger industrial users are often penalized in the form of higher electricity prices for peak electricity demands that exceed the industry's base load requirements, especially when the industry requires instantaneous and short spikes, for example when starting an electric motor. Starting an electric motor can require up to a 650 percent increase in the normal operating demand of the electric motor while starting the motor. This power demand requires the utility to have the extra capacity in reserve. This reserve or peak load demand is more expensive to provide. The extra cost in most cases makes the use of electric motor driven compressors less feasible than running a gas compressor on a reciprocating gas engine.

[0005] Reciprocating gas engine driven compressors are utilized in the majority of gas compressor stations. A portion of the natural gas being forwarded at the gas compressions station is utilized to operate the natural gas fired engines that drive the gas compressors. Due to the high cost of a reciprocating gas fired engine, most gas compressor units utilize high speed reciprocating gas engines in the compressor packages to reduce cost, rather than utilizing slower speed engines. The operations and maintenance cost of the reciprocating gas engines is usually high and a large portion of the overall cost of operating a gas compressor. Unscheduled down time due to unexpected engine failures are a common complaint, and major overhauls of the engine are costly and frequently required. In comparison, an electric motor driven compressor is appealing since an electric motor driven compressor requires less maintenance and increased run time for the gas compression system operators, subject to the cost constraints of electricity.

[0006] It is thus desirable to reduce the cost of operating and maintaining gas compression operations, while increasing efficiency of the system employing the gas compressor.

SUMMARY OF THE INVENTION

[0007] It is an object of the invention to provide an alternative drive source to power a gas compressor such that cost is reduced, while maintenance and operating simplicity are magnified. A dual drive mechanism provides an opportunity to reduce the price of electricity to operate a gas compressor on an electric motor, and allows a compressor operator to choose to operate the gas compressor on a reciprocating engine or on an electric motor, depending on the economic advantages of the energy source. When compared to current methods and technology for driving a gas compressor, the dual drive mechanism provides significant economic benefit to gas compression operators.

[0008] The dual drive mechanism accomplishes such improvements by incorporating the use of a pulley and belt drive system to effectively provide the options of driving a single gas compressor on an electric motor or on a reciprocating engine. The dual drive mechanism is designed to retrofit an existing compressor that is modified to accept the new dual drive mechanism and the addition of an electric motor, or a new gas compressor unit can be assembled with the dual drive mechanism. Retrofitting modifications can be accomplished using a kit.

[0009] The dual drive mechanism will allow the operator to startup the gas compressor and bring it up to speed with a reciprocating engine. Through use of an electronic load-sharing device, the electric motor will slowly begin to take over driving the compressor. The dual drive mechanism prevents the electric motor from requiring any peak or instantaneous load demands from the utility, and allows the utility to provide the electricity required to operate the motors at optimally reduced rates. The utility will benefit from a constant base load consumption of electricity without peak load demands, and the larger the load, the better the benefit.

[0010] In circumstances where the utility offers a floating rate to industry customers, or where the price of natural gas fluctuates, the compressor station operators can switch back and forth from the engine drive or electric motor drive depending on the price of electricity verses the price of gas. The fluctuations in the price of gas are a daily occurrence to which the industry pays close attention. Thus, the retrofitted dual drive system includes an operations and monitoring controls package that allows the unit to be switched over from one drive to the other from a remote location, or local computer network. For example, a desktop or a laptop computer modem or phone line can be connected and communicate with the system installed on the modified compressor.

[0011] When operating the compressor on the electric motor, the compression station operator can increase the profitability of his operations by selling the available natural gas that is not being burnt as fuel in the natural gas reciprocating engine.

[0012] Many gas compression operators operate gas compression stations that could increase their capacity (throughput) at certain sites by adding more gas compressor units,

but cannot, due to the emissions of current engines installed at the site. The dual drive mechanism will allow an increase in compression capacity at such sites by switching those sites to the dual drive mechanism and running the compressor off of the electric motor instead of the engines.

[0013] Further, the dual drive mechanism increases redundancy due to the dual drive. Should the electric motor fail or be in need of repair or maintenance, the compressor can be run on the reciprocating engine until the unit can be put back into service operating on the electric motor, or visa versa. The option of switching to a different manner of operation can significantly increase efficient production.

BRIEF DESCRIPTION OF THE FIGURES

[0014] For a better understanding of the present invention, reference is made to the figures which are incorporated herein by reference and in which:

[0015] **FIG. 1** is a plain view drawing of the twin drive mechanism common skid mounted with an electric motor and a reciprocating engine driven gas compressor according to one embodiment of the invention;

[0016] **FIG. 2** is an elevation drawing of the twin drive and shaft mechanism according to one embodiment of the invention; and

[0017] **FIG. 3** is a plain view drawing illustrating the modification process for existing compressor units.

DETAILED DESCRIPTION OF THE INVENTION

[0018] A dual drive mechanism for a gas compressor is used in the gathering of natural gas. The dual drive mechanism can be used in other industries and for other applications in addition to the natural gas and oil industries. The dual drive mechanism can be used to drive a single gas compressor or a plurality of gas compressors, as will be apparent according to the description below.

[0019] A dual drive mechanism for use in driving a gas compressor includes a twin shaft drive mechanism. With reference to **FIG. 1**, it is shown that the twin drive mechanism effectively transfers the physical shaft break horsepower of either an engine or an electric motor to a single shaft drive of a gas compressor. **FIG. 1** shows an engine crankshaft and a compressor crankshaft that share the same centerline. The engine is equipped with a weighted flywheel (sized from torsional analysis) and an overrunning clutch assembly. With continued reference to **FIG. 1** and referring to **FIG. 2**, the engine drive shaft extends from beyond the overrunning clutch and is flange bolt connected to the center drive shaft section 1 of the dual drive mechanism. As illustrated, **FIG. 2** shows that the electric motor is equipped with a steel flex coupling and shaft flange bolted to the center drive shaft 2 of the dual drive mechanism. The engine drive shaft 1 extends through the end of the rear pillar block bearing and is flange bolt connected to a steel flex coupling. The shaft extends beyond the steel flex coupling and is flange bolt connected to a weighted flywheel mounted on the gas compressor crankshaft. The electric motor drive shaft 2 extends through the end of the rear pillar block and terminates.

[0020] An existing gas compressor unit can be retrofitted with the dual drive mechanism. For example, an existing

unit can be shipped to the Genergistics facility in Houston, Tex. so that the existing unit can be retrofitted. Referring to **FIG. 3**, the existing unit steel skid is cut in half at a point between the engine and the gas compressor, and the unit is separated into two corresponding sections. The dual drive mechanism is then mounted onto a fabricated steel skid matching the dimensions of the existing unit steel skid, which is installed and fitted as an added middle section between the engine section of the steel skid and the compressor section of the steel skid. The dual drive shafting mechanism is then connected to the engine and compressor crankshafts through the dual drive mechanism flex couplings, shafts and the overrunning clutch assemblies. The electric motor is then mounted on another steel skid matching the dimensions of the steel skid of the existing unit, and attached to the newly modified skid with permanent alignment brackets, such as using steel bolts. Other attachment means are foreseeable and effective.

[0021] Referring again to **FIG. 1** and **FIG. 2**, a shaft mounted drive pulley is mounted on drive shaft 1 and on drive shaft 2 of the dual drive mechanism, and a single drive belt connects the twin drive shafts together.

[0022] The dual drive mechanism along with the overrunning clutch allows the compressor to be driven by either the engine or the electric motor. The mechanism and overrunning clutch allows the compressor to be started up and driven by the engine. During this time, the engine is driving the compressor and rotating the electric motor at the same time. The electric motor is then energized and electrically excited to exceed the RPMs of the engine. Once the electric motor exceeds the RPMs of the engine, the operating overrunning clutch allows the electric motor to begin to drive the compressor. The engine is then slowed down to a stop, and the electric motor takes over in running the compressor continuously.

[0023] If the operator of the compressor wishes to run the compressor on the engine only, the electric motor is rotated along with the compressor and the added inertia is designed to enhance stability. If the operator does not want to run the electric motor, it can be easily isolated from the drive by removing the shaft flange bolts, and the removal of the electric motor is possible if desired.

[0024] What has been described is a specific design of dual drive mechanism intended for use on gas compressors that offers the above described features and benefits. The dual drive mechanism can be integrated into newly designed gas compressors or retrofitted into existing gas compressors to improve energy efficiency in the collection of natural gas. Possible modifications on the system as described are possible and envisioned.

[0025] Having thus described at least one illustrative embodiment of the invention, various alterations, modifications and improvements will readily occur to those skilled in the art. Such alterations, modifications and improvements are intended to be within the scope and spirit of the invention. Accordingly, the foregoing description is by way of example only and is not intended as limiting.

I claim:

1. In a dual-drive system for operating a natural gas compressor using a natural gas engine, an electric motor, or both to redundantly and alternatively drive the natural gas

compressor, the improvement comprising: retro-fitting a pre-existing natural gas compression system that includes a natural gas engine and a natural gas compressor operably connected to each other by a main drive shaft, said retro-fitting being effected by providing an electric motor operably connected to a second drive shaft and means to operably connect said second drive shaft to the main drive shaft

so that the electric motor can drive the natural gas compressor.

2. The improvement of claim 1, wherein the means to operably connect said second drive shaft to the main drive shaft is a pulley and belt drive system.

3. The improvement of claim 1, wherein the main and second drives share load.

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