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Pressurization system of a cooling circuit of an internal combustion engine installed in an engine driven unit

(57) The invention is related to a pressurization system (10) of a cooling circuit of an internal combustion engine installed in an engine driven unit, comprising a coolant tank (14) integrated into the cooling circuit, a pressure source (12) comprising a pump (13), a pressurization line (16) connecting the pressure source (12) and the coolant tank (14) for pressurizing the coolant tank (14), and a control unit (20) for controlling the operation of the pump (13). The invention is characterized in that the pressurization system (10) further comprises at least one pressure sensor (24) disposed to detect a pressure

within the cooling circuit, wherein the pressure sensor (24) is connected to the control unit (20) to communicate pressure data representing the detected pressure to the control unit (20), and the control unit (20) comprises a data interface (30) for receiving status data representing an operation state of the engine driven unit unit, and the control unit (20) is provided to control the operation of the pump (13) so as to regulate the pressure within the cooling circuit to a pressure level that is determined on the present status data received via the data interface (30).

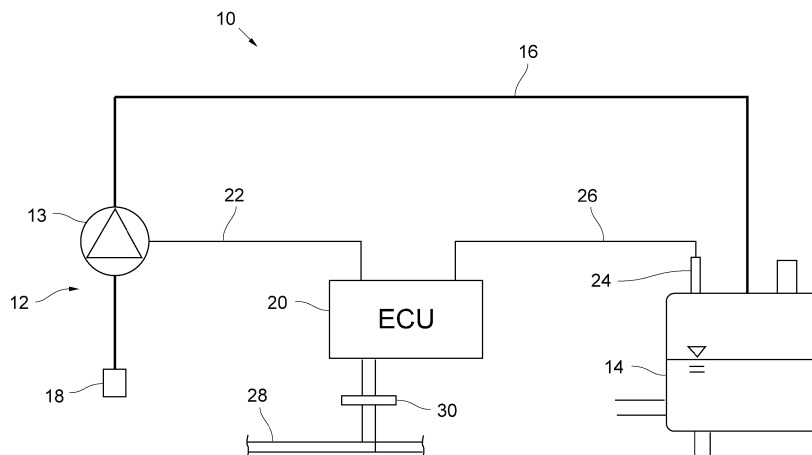


Fig. 1

Description

[0001] The present invention is related to a pressurization system of a cooling circuit of an internal combustion engine installed in an engine driven unit, according to the preamble of claim 1.

[0002] In internal combustion engines, it is common to pressurize the cooling circuit for cooling the engine to a certain pressure, for example, to avoid boiling of the cooling fluid (i. e. water) or cavitation within the cooling circuit. For example, in utility vehicles, the coolant tank is pressurized by a pressure source like an external air pressure circuit that is also used for other purposes. It is to be noted that utility vehicles only represent one example of an engine driven unit to which the present invention can be applied. The invention is applicable to wheeled and/or tracked vehicles of any kind, as well as to ships or emergency generators.

[0003] Because the pressure of the external pressure circuit is usually very high, provisions must be taken to protect the coolant tank from an over pressure. These provisions can include pressure limiting valves disposed within the pressurizing line, to reduce the high pressure of the common pressure circuit down to a lower pressure. Solenoid valves can be used to control the pressure supply to the coolant tank.

[0004] In same cases it may be desired to choose between different pressures to be supplied to the coolant tank. In this case it is necessary to provide different pressure limiting valves in different branches of the pressurization line, each pressure limiting valve being set to another output pressure. Moreover, a number of different solenoid valves is necessary for control of the supply through the different branches. Such a layout is disclosed, for example, in DE 10 2007 058 575 B4.

[0005] Because the layout of such pressurization systems is very inflexible and comprises a large number of components, it may also be envisaged to use a pressure source different from the external high pressure circuit, namely a pump or a compressor. This pressure source is controlled by a corresponding control unit.

[0006] In many applications it is desired to control the pressure within the cooling circuit according to an operation state of the engine driven unit. For example, these operation states may include the on/off-state of the engine (i.e. the ignition), the operation state of the water pump, or the temperature within the cooling circuit. In systems comprising a pump as a pressure source, there is no existing possibility to adapt the pressure supplied to the coolant tank to the present operation state of the engine driven unit and to hold the pressure within the coolant tank at a predetermined level corresponding to this state at the same time. In this respect it is also desired to regulate the pressure continuously, without being restricted to certain pressure levels, as in the state of the art.

[0007] It is therefore an object of the present invention to provide a pressurizing system of the above kind that regulates the pressure supplied to the coolant tank con-

tinuously according to an operation state of the engine driven unit by simple means.

[0008] This object is achieved by a pressurizing system comprising the features of claim 1.

[0009] A pressurizing system according to the present inventions comprises at least one pressure sensor disposed to detect the pressure within the cooling circuit. It is connected to the control unit of the pump to communicate pressure data representing the detected pressure to the control unit. Moreover, the control unit comprises a data interface for receiving status data representing an operation state of the engine driven unit. The control unit is provided to control the operation of the pump so as to regulate the pressure within the cooling circuit to a pressure level that is determined on the present status data received via the interface.

[0010] According to a preferred embodiment of the present invention, the pressure sensor is disposed to detect the air pressure within the coolant tank. In this example the pressure sensor can be positioned within the tank above the fluid level.

[0011] According to a preferred embodiment of the present invention, the pressure sensor is disposed to detect the pressure of the cooling fluid. In this case the pressure sensor can be positioned in front of or after a fluid pump for circulating the cooling fluid within the cooling circuit. It is also possible to use more than one sensor, for example, a first sensor for detecting the air pressure within the coolant tank, and a second sensor to detect the fluid pressure within the cooling circuit, and to use one or both pressure signals for regulation.

[0012] If a defined operation state of the engine driven unit is recognized by the control unit, a corresponding target pressure can be calculated by the control unit or can be allocated to the operation state while it has been previously stored within a memory of the control unit. This target pressure can be compared to pressure detected by the pressure sensor. The pump can be controlled accordingly to regulate the pressure within the coolant tank to the target pressure. For example, if the detected pressure within the cooling circuit is too low, the control unit will increase the power of the pump to build up a higher pressure. On the other hand, if there is an over pressure in the cooling circuit with respect to the present operation state of the engine driven unit, the control unit controls the pump to lower the pressure supplied via the pressurization line.

[0013] According to a preferred embodiment of the present invention, the control unit is provided to calculate a control signal from the pressure data and the status data and to transmit the control signal to the pump.

[0014] Preferably the status data comprise at least one of the following group:

- Engine ignition status, indicating if the engine ignition is activated or not;
- Cooling system temperature status, indicating if the temperature within the cooling system is higher than

a predetermined temperature value or not.

[0015] Other significant operational states can also be used that are important for the protection of the engine against cavitation.

[0016] The control unit can calculate logical states from this status data mentioned above (for example, engine ignition activated AND temperature value above a predetermined level) and calculate the control signal for the pump accordingly).

[0017] The present invention also refers to an engine driven unit, comprising a pressurization system as described above.

[0018] Such engine driven unit may preferably comprise a data bus system to transmit status data representing an operation state of the engine driven unit, wherein the data interface of the control unit is connected to this data bus system. In this embodiment the control unit can use status data that are already present within the bus system for controlling the pump.

[0019] Preferably this engine driven unit is represented by a utility vehicle.

[0020] These and other aspects of the invention will be apparent from and elucidated with reference to preferred embodiments of the invention described hereinafter.

[0021] Fig. 1 and 2 are schematic views of layouts of pressurization systems representing a first embodiment and a second embodiment of the present invention.

[0022] Fig. 1 is a schematic view of a pressurization system 10 according to a first embodiment of the present invention. This pressurization system 10 is provided to pressurize the cooling circuit of an internal combustion engine installed in an engine driven unit, like, for example, a utility vehicle. Within the pressurization system 10, a pressure source 12 is connected with a coolant tank 14 by a pressurization line 16. The coolant tank 14 is integrated into the cooling circuit. The pressure source 12 comprises a pump 13 to pressurize a fluid originating from a general fluid reservoir to be supplied to the coolant tank 14. This fluid reservoir can be represented by, for example, the environmental atmosphere at a normal environmental pressure level, which is raised continuously by the pump 13 to a higher pressure level, e.g., in a range from 0 bar to about 6 bar (abs) or 600 kPa. Reference 18 denotes an air filter.

[0023] The power of the pump 13 is variable and can be raised or lowered to increase or decrease the output pressure of the pump 13. For controlling the pump 13, a control unit 20 is provided that is electrically connected to the pump 13 via a control line 22. This control unit 20 can also provide other control functions of the operation of the engine and is designated as ECU (engine control unit) accordingly. However, this designation shall not be understood as limiting for the control function of the pump 13. The control unit 20 can rather also be an independent control unit.

[0024] At the coolant tank 14, a pressure sensor 24 is provided to detect the air pressure within the coolant tank

14. This pressure sensor 24 is connected to the control unit 20 via a data line 26 so that present pressure data can be transmitted from the pressure sensor 24 to the control unit 20, representing the actual pressure within the coolant tank 14.

[0025] The control unit is further connected to a bus system 28 of the engine driven unit via a data interface 30, so that status data transmitted within the bus system 28 can be transmitted via the interface 30 to the control unit 20. These status data may comprise, for example, data indicating the engine ignition status, i.e. indicating if the engine ignition is activated or not, and/or a cooling system temperature status data, indicating if the temperature within the cooling system is higher than a predetermined temperature value or not. However, these types of data as mentioned before are not understood to be limiting. The status data transmitted within the bus system 28 may also comprise other status data, and the present invention is not limited with respect to the type of status data transmitted to the control unit 20. These status data have in common that they represent an operation state of the engine driven unit. This means that the control unit 20 is provided with an information of this operation state, represented by these status data received via the interface 30.

[0026] From the status data received, the control unit 20 can calculate a target pressure level of the coolant tank 14 corresponding to the present state of the engine driven unit. This means that one pressure level of the coolant tank 14 may be desired in one determined operation state of the engine driven unit, while another pressure level, i.e. a higher or lower pressure level may be desired in another operation state. Additionally, the control unit 20 receives the pressure data via the data line 26 from the pressure sensor 24. On this basis the control unit 20 can determine whether or not the actual pressure within the coolant tank 14 corresponds to the desired pressure with respect to the present operation state of the engine driven unit. If this is not the case, the operation of the pump 13 can be controlled accordingly. For example, if the present pressure within the coolant tank 14 is lower than the target pressure corresponding to the present operation state of the engine driven unit, the control unit 20 transmits a control signal via the control line 22 to the pump 13 to increase the pump power and to raise the pressure level. On the other hand, if there is an over pressure within the coolant tank 14, the pump 13 is controlled to decrease its power. In this arrangement, the operation of the pump 13 can be controlled by the control unit 20 so as to regulate the pressure within the coolant tank 14 to a pressure level that is determined on the present status data as received via the interface 30.

[0027] Fig. 2 is a schematic view of a pressurization system 100 according to a second embodiment of the present invention. In this pressurization system 100, the pressure sensor 24 is disposed upstream a fluid pump 102 to detect the pressure of the cooling fluid. The other elements of the pressurization system 100 are the same

as to the pressurization system 10 of the first embodiment, and so a detailed description thereof is omitted here for the sake of brevity.

Claims

1. Pressurization system (10) of a cooling circuit of an internal combustion engine installed in an engine driven unit, comprising:

a coolant tank (14) integrated into the cooling circuit,
a pressure source (12) comprising a pump (13),
a pressurization line (16) connecting the pressure source (12) and the coolant tank (14) for pressurizing the coolant tank (14),
and a control unit (20) for controlling the operation of the pump (13),

characterized in that the pressurization system (10) further comprises at least one pressure sensor (24) disposed to detect a pressure within the cooling circuit,

wherein the pressure sensor (24) is connected to the control unit (20) to communicate pressure data representing the detected pressure to the control unit (20),

and the control unit (20) comprises a data interface (30) for receiving status data representing an operation state of the engine driven unit unit, and the control unit (20) is provided to control the operation of the pump (13) so as to regulate the pressure within the cooling circuit to a pressure level that is determined on the present status data received via the data interface (30).

2. Pressurization system according to claim 1, **characterized in that** the pressure sensor (24) is disposed to detect the air pressure within the coolant tank (14).

3. Pressurization system according to claim 1, **characterized in that** the pressure sensor (24) is disposed to detect the pressure of the cooling fluid.

4. Pressurization system according to claim 1, **characterized in that** the control unit (20) is provided to calculate a control signal from the pressure data and the status data and to transmit the control signal to the pump (13).

5. Pressurization system according to one of the preceding claims, **characterized in that** the status data comprise at least one of the following group:

- engine ignition status, indicating if the engine ignition is activated or not;
- cooling system temperature status, indicating if the temperature within the cooling system is

higher than a predetermined temperature value or not.

6. Engine driven unit, comprising an internal combustion engine, **characterized by** a pressurization system (10) according to one of the preceding claims.

7. Engine driven unit according to claim 4, **characterized by** a data bus system (28) to transmit status data representing an operation state of the engine driven unit, wherein the data interface (30) of the control unit (20) is connected to this data bus system (28).

8. Engine driven unit according to one of claims 6 or 7, **characterized in that** the engine driven unit is a utility vehicle.

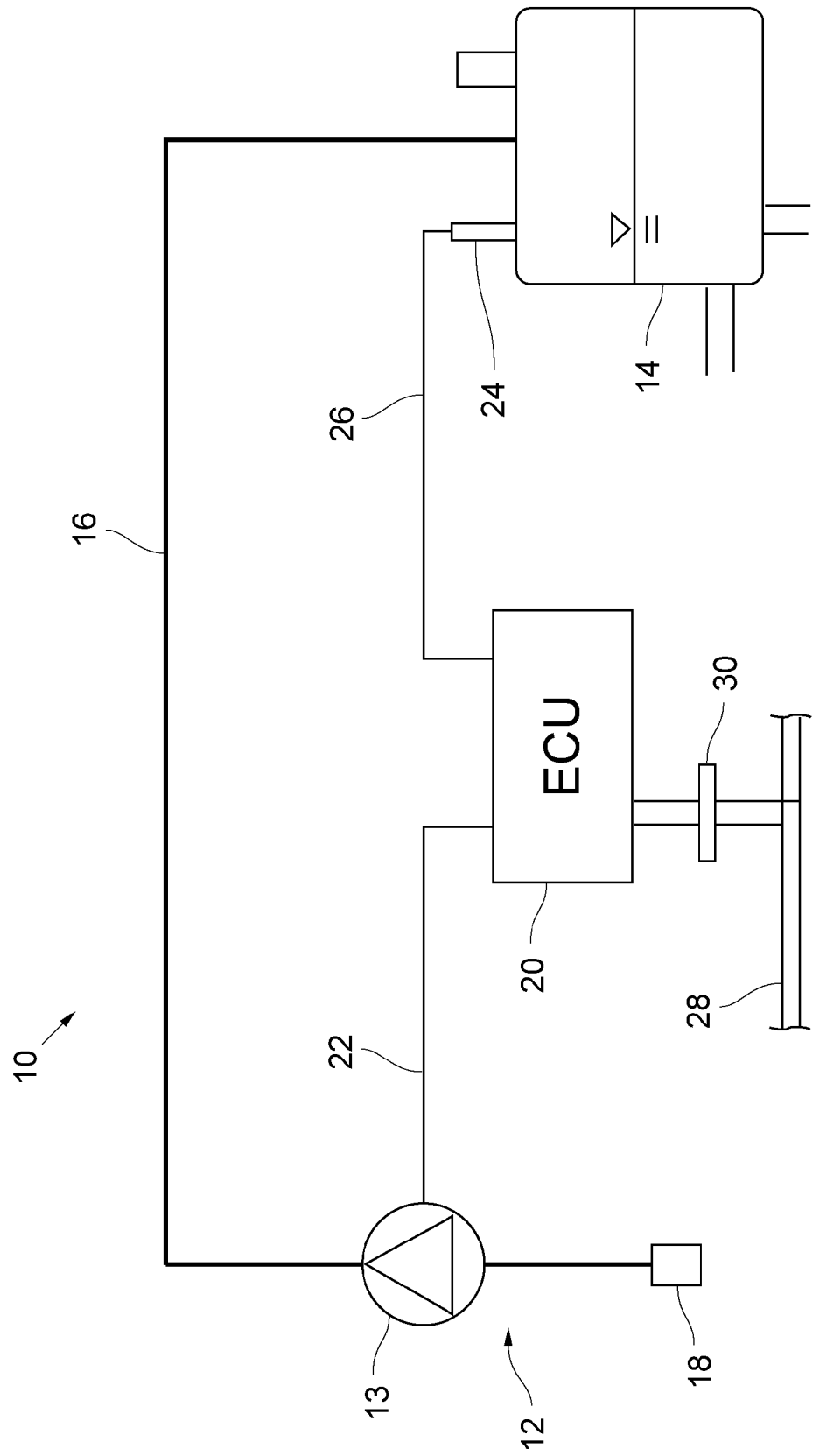


Fig. 1

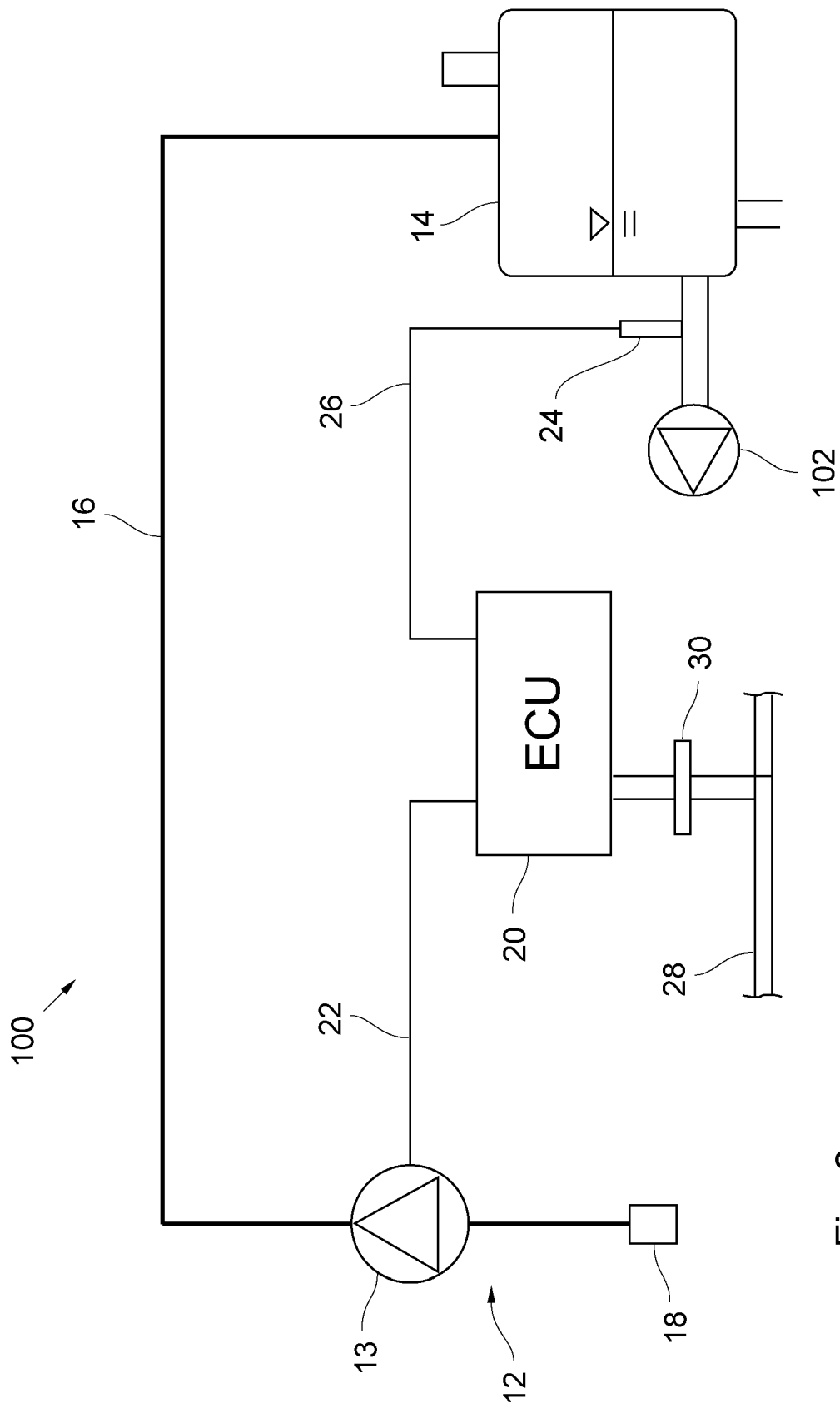


Fig. 2



EUROPEAN SEARCH REPORT

 Application Number
EP 14 16 3018

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
Munich		8 September 2014	Schwaller, Vincent
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 16 3018

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