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United States Patent Application Publication 20250264046
Kind Code A1
Publication Date August 21, 2025
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PURIFICATION SYSTEM

Abstract

[Solution] A purification system includes an engine, a catalyst that causes adsorbed ammonia to react with nitrogen oxide contained in exhaust gas of the engine to purify the exhaust gas, a motor that is driven to compensate for the difference between a) an engine load of the engine and b) a driving load, when the driving load of a driven device driven by the engine changes, a battery that supplies electricity to the motor, and a setting part that sets a target value so that the target value of the adsorption amount of the catalyst increases as the remaining capacity of the battery increases.

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Family ID: **1000008466490**

Appl. No.: **19/039388**

Filed: **January 28, 2025**

Foreign Application Priority Data

JP 2024-022977 Feb. 19, 2024

Publication Classification

Int. Cl.: **F01N3/20** (20060101); **F01N3/08** (20060101)

U.S. Cl.:

CPC **F01N3/206** (20130101); **F01N3/0814** (20130101); F01N2610/02 (20130101); F01N2900/104 (20130101); F01N2900/1616 (20130101)

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS
[0001] The present application claims priority to Japanese Patent Applications No. 2024-22977, filed on Feb. 19, 2024, contents of which are incorporated herein by reference in their entirety.
BACKGROUND OF THE INVENTION
[0002] The present disclosure relates to a purification system for purifying exhaust gas of an engine. A technique for purifying exhaust gas of an engine is known. Japanese Unexamined Patent Application Publication No. 2009-113580 discloses a technique for purifying exhaust gas by providing, in an exhaust passage of an engine, a catalyst that adsorbs ammonia and facilitates a reaction between the adsorbed ammonia and nitrogen oxides in the exhaust gas.
[0003] When a large amount of ammonia is adsorbed to a catalyst, the reaction between nitrogen oxides in exhaust gas and the ammonia is facilitated, thereby improving an exhaust gas purification rate. However, if exhaust gas temperature increases while a large amount of ammonia is adsorbed to a catalyst, there is a risk that the ammonia may desorb from the catalyst and be released into the atmosphere without reacting with nitrogen oxides.
BRIEF SUMMARY OF THE INVENTION
[0004] The present disclosure focuses on this point, and an object thereof is to achieve both improvement of an exhaust gas purification rate and suppression of release of ammonia to the atmosphere.
[0005] An aspect of the present disclosure provides a purification system including an engine, a catalyst that causes adsorbed ammonia to react with nitrogen oxide contained in exhaust gas of the engine to purify the exhaust gas, a motor that assists the engine, a battery that supplies electricity to the motor, and an injection controller that controls an amount of urea to be injected so that an adsorption amount of the ammonia adsorbed to the catalyst increases as remaining capacity of the battery increases.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0006] FIG. **1** illustrates a configuration of a purification system according to the present embodiment.
[0007] FIG. **2** illustrates a relationship between exhaust gas temperature and an adsorption capacity limit.
[0008] FIG. **3** illustrates a configuration of a control device.
[0009] FIG. **4** illustrates a relationship between remaining capacity and a target value.
[0010] FIG. **5** is a flowchart showing an example of a process for setting the target value.
DETAILED DESCRIPTION OF THE INVENTION
[0011] Hereinafter, the present disclosure will be described through exemplary embodiments of the present disclosure, but the following exemplary embodiments do not limit the disclosure according to the claims, and not all of the combinations of features described in the exemplary embodiments are necessarily essential to the solution means of the disclosure.
[Configuration of Purification System S]
[0012] FIG. **1** illustrates a configuration of a purification system S according to the present embodiment. The purification system S shown in FIG. **1** is a system for purifying exhaust gas of an engine **1**. The purification system S is provided in a vehicle, a ship, and the like, for example. In the following description, the purification system S is assumed to be mounted on a vehicle. The purification system S includes the engine **1**, a purification device **2**, a urea injection part **3**, a driven device **5**, a control device **6**, a motor **41**, and a battery **42**.
[0013] The engine **1** is an internal combustion engine that generates power by combusting and

expanding a mixture of fuel and intake air. The engine **1** is a diesel engine, for example, but may be a gasoline engine. The driven device **5** is coupled to an output shaft **12** of the engine **1**. The engine **1** drives the driven device **5**.

[0014] The driven device **5** is a transmission, a drive shaft, and a tire-wheel assembly, for example, but is not limited thereto. In the following description, a load required to drive the driven device **5** may be referred to as a driving load.

[0015] The motor **41** is provided between the engine **1** and the driven device **5** on the output shaft **12**. The motor **41** assists the engine **1** and drives the driven device **5**. The motor **41** is operated by electricity supplied from the battery **42**. Further, the motor **41** also functions as a generator. The motor **41** generates electricity by being driven by the power of the engine **1**.

[0016] The purification device **2** is provided in an exhaust pipe **11** that discharges exhaust gas of the engine **1** to the outside. The purification device **2** purifies the exhaust gas discharged from the engine **1**. A catalyst **21** is provided inside the purification device **2**. The catalyst **21** is a selective reduction catalyst that purifies the exhaust gas by causing nitrogen oxides contained in the exhaust gas to react with ammonia. Specifically, the catalyst **21** facilitates the reaction between nitrogen oxides and ammonia at or above its activation temperature, thereby converting the nitrogen oxides into water and nitrogen. The activation temperature is 200 degrees Celsius, for example, but is not limited thereto.

[0017] The urea injection part **3** is provided between the engine **1** and the catalyst **21** in the exhaust pipe **11**. The urea injection part **3** injects urea, which is a precursor of ammonia, into the exhaust pipe **11**. Specifically, the urea injection part **3** injects urea water containing urea into the exhaust pipe **11**. Urea in the urea water injected into the exhaust pipe **11** is hydrolyzed to ammonia by heat of the exhaust gas. The ammonia is adsorbed to the catalyst **21**. The catalyst **21** facilitates the reaction between the adsorbed ammonia and the nitrogen oxides contained in the exhaust gas to purify the exhaust gas.

[0018] When a large amount of ammonia is adsorbed to the catalyst **21**, the reaction between the nitrogen oxides in the exhaust gas and the ammonia is facilitated, thereby improving an exhaust gas purification rate. However, an adsorption capacity limit indicating the maximum amount of ammonia that can be adsorbed to the catalyst **21** is determined on the basis of the temperature of the catalyst **21**. Specifically, the adsorption capacity limit decreases as the temperature of the catalyst **21** increases. Therefore, when the temperature of the catalyst **21** increases due to an increase in exhaust gas temperature, the adsorption capacity limit decreases, and ammonia adsorbed to the catalyst **21** desorbs. It should be noted that the temperature of the catalyst **21** is linked to the exhaust gas temperature, therefore, in the following description, the temperature of the catalyst **21** is assumed to be equal to the exhaust gas temperature.

[0019] FIG. **2** illustrates a relationship between the exhaust gas temperature and the adsorption capacity limit. In FIG. **2**, the horizontal axis represents exhaust gas temperature T, and the vertical axis represents an adsorption amount of ammonia Q on the catalyst **21**. An adsorption capacity limit L is a graph showing an adsorption capacity limit according to the exhaust gas temperature T. The adsorption capacity limit L decreases as the exhaust gas temperature T increases. An activation temperature E is a temperature at which the catalyst **21** is activated. As described above, since the temperature of the catalyst **21** is linked to the exhaust gas temperature T, when the exhaust gas temperature T becomes equal to or higher than the activation temperature E, the catalyst **21** temperature also becomes equal to or higher than the activation temperature E. Hereinafter, desorption of ammonia adsorbed to the catalyst **21** due to an increase in the exhaust gas temperature T will be described.

[0020] For example, when the exhaust gas temperature Tis at the activation temperature E and the adsorption amount of ammonia Q is at a first adsorption amount A, the exhaust gas temperature T increases to temperature T**1**. In this case, the adsorption capacity limit L of ammonia decreases from the first adsorption amount A to a second adsorption amount B. That is, ammonia can only be adsorbed to the catalyst **21** up to the second adsorption amount B. Therefore, an amount of ammonia corresponding to a difference between the first adsorption amount A and the second adsorption amount B desorbs from the catalyst **21** and is released into the atmosphere. Conversely, even when a large amount of ammonia is adsorbed to the catalyst **21**, if the exhaust gas temperature T does not increase, the ammonia adsorbed to the catalyst **21** does not desorb and therefore is not released into the atmosphere.

[0021] Therefore, the control device **6** suppresses the increase in the exhaust gas temperature by operating the engine **1** in a steady state so that an engine load of the engine **1** is constant, thereby suppressing the release of ammonia into the atmosphere. During the steady-state operation of the engine **1**, the control device **6** causes the motor **41** to output for compensating a difference between a) the driving load of the driven device **5** and b) the engine load of the engine **1** during the steady-state operation. The amount of load by which the motor **41** can compensate for the difference is determined by the remaining capacity of the battery **42**, and is greater as the remaining capacity of the battery **42** is larger. For example, when the remaining capacity of the battery **42** is large, the motor **41** can compensate for the difference in load over a longer period. This allows the engine **1** to continue its steady-state operation even if the driving load remains greater than the engine load of the engine **1** during steady-state operation.

[0022] When the engine **1** is in the steady-state operation, the increase in the exhaust gas temperature is suppressed, thereby reducing the risk of ammonia desorbing from the catalyst **21** due to the increase in the exhaust gas temperature, even when a large amount of ammonia is adsorbed to the catalyst **21**. If the risk of desorption of ammonia is small, the control device **6** increases the adsorption amount of ammonia on the catalyst **21**. The increase in the adsorption amount of ammonia on the catalyst **21** facilitates purification of the exhaust gas by the catalyst **21**, thereby improving the exhaust gas purification rate. In this way, the control device **6** can achieve both suppression of the release of ammonia to the atmosphere and the improvement of the exhaust gas purification rate. Hereinafter, the configuration of the control device **6** will be specifically described.

[Configuration of Control Device **6**]

[0023] FIG. **3** illustrates a configuration of a control device **6**. The control device **6** includes a storage **61** and a controller **62**. The storage **61** is a storage medium including a Read Only Memory (ROM), a Random Access Memory (RAM), a hard disk, and the like. The storage **61** stores a program executed by the controller **62**.

[0024] The controller **62** is a calculation resource including a processor such as a Central Processing Unit (CPU). The controller **62** achieves functions of an acquisition part **621**, a setting part **622**, an injection controller **623**, and a drive controller **624** by executing the program stored in the storage **61**.

[0025] The acquisition part **621** acquires information related to the purification system S. The acquisition part **621** acquires the remaining capacity of the battery **42**, for example. The acquisition part **621** acquires capacity information indicating the remaining capacity from a battery monitoring system that monitors the remaining capacity of the battery **42**. The acquisition part **621** may i) calculate power consumption of the motor **41** from an output of the motor **41**, and ii) acquire a value obtained by subtracting the power consumption of the motor **41** from the maximum capacity of the battery **42** for a period from when the battery **42** reaches the maximum capacity to the present time, as the remaining capacity of the battery **42**.

[0026] The acquisition part **621** acquires load information indicating the driving load of the driven device **5**. For example, the acquisition part **621** acquires the load information indicating the driving load of the driven device **5** from a sensor provided in the driven device **5**. The sensor is a torque sensor that detects torque as the driving load, for example, but is not limited thereto.

[0027] The setting part **622** sets a target value of the adsorption amount of ammonia on the catalyst **21**. For example, the setting part **622** sets a target value M according to remaining capacity SOC.

FIG. **4** illustrates a relationship between the remaining capacity SOC and the target value M. In FIG. **4**, the horizontal axis represents the remaining capacity SOC, and the vertical axis represents the target value M of the adsorption amount.

[0028] A lower limit target value C is defined as a value at which the ammonia is not insufficient relative to the nitrogen oxides contained in the exhaust gas. In other words, the lower limit target value C is defined as an adsorption amount at which the exhaust gas purification rate of the catalyst **21** is maintained at or above a predetermined purification rate lower limit value. The purification rate lower limit value corresponds to a value at which an amount of nitrogen oxides emitted to the atmosphere remains below an emission reference value, for example. It should be noted that, if the adsorption amount falls below the lower limit target value C, the ammonia becomes insufficient relative to the nitrogen oxides, making it impossible to adequately purify the exhaust gas.

[0029] The setting part **622** sets the target value M for the adsorption amount at which the catalyst **21** can purify the exhaust gas even if the remaining capacity SOC is small. Specifically, the setting part **622** sets the target value M to the lower limit target value C if the remaining capacity SOC is less than first capacity D. This ensures that the setting part **622** can maintain the exhaust gas purification rate at or above the purification rate lower limit value even if the remaining capacity SOC is small.

[0030] An upper limit target value A**1** is a limit value of an amount of ammonia that the catalyst **21** can adsorb when the exhaust gas temperature is the activation temperature E, and is equal to the first adsorption amount A (see FIG. **2**). If a larger amount of ammonia than the upper limit target value A**1** is supplied to the catalyst **21** at the activation temperature E, some of the supplied ammonia cannot be adsorbed to the catalyst **21** and is released to the atmosphere. If the exhaust gas temperature is lower than the activation temperature E, the catalyst **21** can adsorb the larger amount of ammonia than the upper limit target value A**1**, but cannot facilitate the reaction between the adsorbed ammonia and the nitrogen oxide. Therefore, it is unnecessary to supply ammonia to the catalyst **21** in an amount equal to or higher than the upper limit target value A**1**.

[0031] The setting part **622** sets the target value M to be equal to or less than the upper limit target value A**1** in order to suppress unnecessary ammonia supply. Specifically, the setting part **622** sets the target value M to the upper limit target value A**1** if the remaining capacity SOC is equal to or greater than second capacity F which is larger than the first capacity D. More specifically, the setting part **622** sets the upper limit target value A**1** to the target value M if the exhaust gas temperature is the activation temperature E and the remaining capacity SOC is equal to or greater than the second capacity F. The second capacity F is 80% of the maximum capacity of the battery **42**, but is not limited thereto and may be the maximum capacity. This allows the setting part **622** to prevent an unnecessarily large amount of ammonia from being supplied to the catalyst **21**.

[0032] If the remaining capacity SOC is equal to or more than the first capacity D and less than the second capacity F, the setting part **622** sets the target value M greater than the lower limit target value C as the remaining capacity SOC increases. The setting part **622** sets the target value M corresponding to the remaining capacity SOC acquired by the acquisition part **621** with reference to relationship information indicating the relationship between the remaining capacity SOC and the target value M. The relationship information is a data table in which the target value M is associated with each of the plurality of remaining capacities SOC. The data table is stored in the storage **61**, for example. The relationship information may be a function that outputs the target value M when the remaining capacity SOC is inputted. The function is a function that outputs the target value M by multiplying the remaining capacity SOC by a positive coefficient, for example. As described above, the setting part **622** can increase the target value M for the adsorption amount as the amount of load by which the motor **41** can compensate for the difference between the engine load of the engine **1** during the steady-state operation and the driving load becomes larger, thereby improving the exhaust gas purification rate.

[0033] The injection controller **623** causes the urea injection part **3** to inject urea water containing urea into the exhaust pipe **11**. The injection controller **623** causes the urea injection part **3** to inject urea water into the exhaust pipe **11** so that the adsorption amount of ammonia on the catalyst **21** becomes the target value M set by the setting part **622**. Specifically, the injection controller **623** first estimates an estimated adsorption amount of ammonia adsorbed to the catalyst **21** at the present time on the basis of the amount of exhaust gas emitted from the exhaust pipe **11** and the amount of urea water injected up to the present time. Next, the injection controller **623** determines whether or not the estimated adsorption amount is less than the target value M. If the estimated adsorption amount is less than the target value M, the injection controller **623** specifies the difference between the estimated adsorption amount and the target value M.

[0034] The injection controller **623** then causes the urea injection part **3** to inject urea water into the exhaust pipe **11** in an amount corresponding to the difference between the estimated adsorption amount and the target value M. Specifically, the injection controller **623** increases the amount of urea water to be injected by the urea injection part **3** as the difference between the estimated adsorption amount and the target value M becomes larger, if the estimated adsorption amount is below the target value M. In this way, the injection controller **623** can increase the adsorption amount of ammonia on the catalyst **21**.

[0035] If the estimated adsorption amount is equal to or greater than the target value M, the injection controller **623** does not specify the difference between the estimated adsorption amount and the target value M, and does not cause the urea injection part **3** to inject the urea water into the exhaust pipe **11**. This allows the injection controller **623** to suppress unnecessary ammonia supply to the catalyst **21**.

[0036] As described in FIG. **2**, supplying ammonia to the catalyst **21** in an amount exceeding the adsorption capacity limit L causes some of the supplied ammonia to be released without being adsorbed by the catalyst **21**. Therefore, the setting part **622** sets the target value M so that the adsorption amount of ammonia Q does not exceed the adsorption capacity limit L. The setting part **622** sets the adsorption capacity limit L to the target value M if the target value M determined according to the remaining capacity SOC is greater than the adsorption capacity limit L determined according to the exhaust gas temperature. This allows the setting part **622** to prevent an unnecessarily large amount of ammonia from being supplied.

[0037] The drive controller **624** controls the engine **1**. When the setting part **622** sets the target value M greater than the lower limit target value C, the drive controller **624** causes the engine **1** to operate in the steady state so that the engine load of the engine **1** is constant. Specifically, the drive controller **624** causes the engine **1** to operate in the steady state so that the engine load of the engine **1** is constant and the exhaust gas temperature becomes equal to or higher than the activation temperature E of the catalyst **21**. More specifically, the drive controller **624** causes the engine **1** to operate in the steady state so that the exhaust gas temperature becomes equal to or higher than the activation temperature E and equal to or lower than upper limit temperature F.

[0038] The magnitude relationship between the engine load of the engine **1** during steady-state operation and the driving load of the driven device **5** varies. For example, when the vehicle is traveling uphill or accelerating, the driving load of the driven device **5** becomes greater than the engine load of the engine **1** during steady-state operation. Conversely, when the vehicle is traveling downhill or coasting, the driving load of the driven device **5** becomes smaller than the engine load of the engine **1** during steady-state operation.

[0039] Therefore, the drive controller **624** switches the operation of the motor **41** according to the magnitude relationship between the engine load of the engine **1** during steady-state operation and the driving load of the driven device **5**. That is, the drive controller **624** switches between causing the motor **41** to a) output power and b) generate electricity, on the basis of the magnitude relationship between the engine load of the engine **1** and the driving load.

[0040] If the driving load is greater than the engine load of the engine **1** during steady-state operation, the drive controller **624** causes the motor **41** to output power corresponding to a difference between the engine load of the engine **1** during steady-state operation and the driving load. Specifically, the drive controller **624** controls the output current of the battery **42** to supply electricity from the battery **42** to the motor **41**, so that the output of the motor **41** becomes equal to the difference. In this way, the drive controller **624** can operate the engine **1** in the steady state even when the vehicle is traveling uphill or accelerating, and can keep the exhaust gas temperature constant. If the driving load is smaller than the engine load of the engine **1** during steady-state operation, the drive controller **624** causes the motor **41** to generate electricity using the difference between the engine load of the engine **1** during steady-state operation and the driving load, by causing the motor **41** to function as a generator. Specifically, the drive controller **624** causes the motor **41** to generate electricity corresponding to the difference between the engine load of the engine **1** during steady-state operation and the driving load. As described above, the drive controller **624** causes the motor **41** to function as a generator, thereby operating the engine **1** in the steady state so that the engine load of the engine **1** does not decrease.

[Process for Setting Target Value M]

[0041] FIG. **5** is a flowchart showing an example of a process for setting the target value M. The process for setting the target value M is executed at predetermined intervals during the operation of the engine **1**. The predetermined interval is 100 milliseconds, for example, but is not limited thereto.

[0042] The acquisition part **621** acquires the remaining capacity SOC of the battery **42** (step S**1**). Specifically, the acquisition part **621** acquires capacity information indicating remaining capacity from the battery monitoring system that monitors the remaining capacity of the battery **42**.

[0043] The setting part **622** determines whether or not the remaining capacity SOC is equal to or greater than the first capacity D (step S**2**). If the remaining capacity SOC is equal to or greater than the first capacity D (Yes in step S**2**), the setting part **622** sets the target value M according to the remaining capacity SOC (step S**3**).

[0044] The drive controller **624** causes the engine **1** to operate in the steady state so that the engine load of the engine **1** is constant (step S**4**). Specifically, the drive controller **624** causes the engine **1** to operate in the steady state so that i) the exhaust gas temperature becomes equal to or higher than the activation temperature E and equal to or lower than the upper limit temperature and ii) the engine load of the engine **1** is constant.

[0045] The acquisition part **621** acquires the difference between the engine load of the engine **1** during steady-state operation and the driving load (step S**5**). The drive controller **624** determines whether or not the driving load is equal to or greater than the engine load (step S**6**). If the driving load is equal to or greater than the engine load (Yes in step S**6**), the drive controller **624** causes the motor **41** to output power corresponding to the difference (step S**7**). Specifically, the drive controller **624** controls the current to be applied to the motor **41** so that the output of the motor **41** becomes equal to the difference.

[0046] If the driving load is less than the engine load (No in step S**6**), the drive controller **624** causes the motor **41** to generate electricity using power corresponding to the difference (step S**8**). Specifically, the drive controller **624** causes the motor **41** to generate electricity corresponding to the difference between the engine load of the engine **1** during steady-state operation and the driving load.

[0047] If the remaining capacity SOC is less than the first capacity D (No in step S**2**), the setting part **622** sets the lower limit target value C to the target value M (step S**9**). The drive controller **624** drives the engine **1** according to the driving load (step S**10**).

[Effects of Purification System S]

[0048] As described above, the purification system S according to the embodiment includes the engine **1**, the catalyst **21**, the motor **41**, and the battery **42** that supplies electricity to the motor **41**. The catalyst **21** purifies the exhaust gas by causing the adsorbed ammonia react with the nitrogen oxides contained in the exhaust gas of the engine **1**. The motor **41** is driven to compensate for the difference between a) the driving load of the driven device **5** driven by the engine **1** and b) the engine load of the engine **1**. The purification system S then increases the target value M of the adsorption amount of ammonia on the catalyst **21** as the remaining capacity of the battery **42** increases.

[0049] According to the above configuration, the purification system S of the present disclosure can increase the adsorption amount of ammonia on the catalyst **21** as the remaining capacity of the battery **42** increases. Further, in the purification system S, the difference between the driving load and the engine load of the engine **1** is compensated by the motor **41** driven by the battery **42**, thereby suppressing fluctuation in the engine load of the engine **1**. As a result, the purification system S can operate the engine **1** in the steady state, which suppresses the increase in the exhaust gas temperature of the engine **1**. Thus, the purification system S can suppress the release of ammonia to the outside even if the adsorption amount of ammonia on the catalyst **21** is increased. Furthermore, the adsorption amount of ammonia on the catalyst **21** can be increased, which facilitates the reaction between nitrogen oxides and ammonia on the catalyst **21**. As a result, the exhaust gas purification rate is improved. In this manner, the purification system S can achieve both the improvement of the purification rate and the suppression of release of ammonia to the atmosphere.

[0050] The present disclosure is explained on the basis of the exemplary embodiments. The technical scope of the present disclosure is not limited to the scope explained in the above embodiments and it is possible to make various changes and modifications within the scope of the disclosure. For example, all or part of the apparatus can be configured with any unit which is functionally or physically dispersed or integrated. Further, new exemplary embodiments generated by arbitrary combinations of them are included in the exemplary embodiments of the present disclosure. Further, effects of the new exemplary embodiments brought by the combinations also have the effects of the original exemplary embodiments.

Claims

1. A purification system comprising: an engine; a catalyst that causes adsorbed ammonia to react with nitrogen oxide contained in exhaust gas of the engine to purify the exhaust gas; a motor that assists the engine; a battery that supplies electricity to the motor; and an injection controller that controls an amount of urea to be injected so that an adsorption amount of the ammonia adsorbed to the catalyst increases as remaining capacity of the battery increases.

2. The purification system according to claim 1, further comprising: a setting part that sets a target value so that the target value of the adsorption amount of the catalyst increases as the remaining capacity increases, wherein the injection controller injects the urea so that the adsorption amount becomes the target value.

3. The purification system according to claim 2, wherein if the remaining capacity is less than a first capacity, the setting part sets, as the target value of the adsorption amount, an adsorption amount at which a purification rate of the exhaust gas by the catalyst is equal to or greater than a value at which an amount of the nitrogen oxides emitted to the atmosphere is less than an emission reference value.

4. The purification system according to claim 2, wherein if the remaining capacity is equal to or greater than second capacity and exhaust gas temperature of the engine is an activation temperature of the catalyst, the setting part sets the target value to an upper limit target value of an amount of the ammonia that the catalyst can adsorb.

5. The purification system according to claim 4, wherein if a target value determined according to the remaining capacity is greater than an adsorption capacity limit indicating the maximum amount of the ammonia that the catalyst can adsorb, which is determined according to the exhaust gas temperature, the setting part sets the upper limit target value to the target value.

6. The purification system according to claim 1, comprising: a drive controller that causes the engine to operate in a steady state so that i) an exhaust gas temperature of the engine becomes equal to or higher than an activation temperature of the catalyst and ii) an engine load of the engine is constant.
7. The purification system according to claim 6, wherein the drive controller causes the motor) to output, if a driving load of a driven device driven by the engine is greater than the engine load of the engine during steady-state operation, power corresponding to a difference between the engine load of the engine during steady-state operation and the driving load, and the motor to generate, if the driving load is smaller than the engine load of the engine during steady-state operation, electricity corresponding to the difference by causing the motor to function as a generator.
8. The purification system according to claim 2, comprising: a urea injection part that is provided in an exhaust pipe for discharging the exhaust gas to the outside and injects the urea into the exhaust pipe, wherein the catalyst is provided downstream of the urea injection part in the exhaust pipe, and the injection controller causes the urea injection part to inject the urea into the exhaust pipe in an amount corresponding to a difference between a) an estimated amount of the adsorption amount of the ammonia adsorbed to the catalyst at the present time and b) the target value set by the setting part.
9. The purification system according to claim 8, wherein the injection controller causes an injection amount of the urea to be injected into the urea injection part to be increased as the difference between the estimated amount and the target value increases, if the estimated amount is less than the target value, and the urea injection part not to inject the urea into the exhaust pipe if the estimated amount is equal to or greater than the target value.