State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-125
Relating to Exemptions under Section 27156 of the Vehicle Code

PATRON INCORPORATED
"HYDROPOWER WATER INJECTION SYSTEM"

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-45-5;

IT IS ORDERED AND RESOLVED: That the installation of Hydropower Water Injection System manufactured by PatRon Incorporated, 1700 Waurika, P.O. Box 1741, Elkhart, Indiana 46515 has been found not to reduce the effectiveness of required motor vehicle pollution control devices and, therefore, is exempted from the prohibitions of Section 27156 of the Vehicle Code for 1983 and older model-year vehicles with conventional, vacuum operated, positive crankcase ventilation systems except for:

1. diesel engine powered vehicles
2. gasoline fuel injected engine powered vehicles

This Executive Order is valid provided that installation instruction for this device will not recommend tuning the vehicle to specifications different from those submitted by the device manufacturer.

Changes made to the design or operating conditions of the device, as exempted by the Air Resources Board, that adversely affect the performance of a vehicle's pollution control system shall invalidate this Executive Order.

Marketing of this device using an identification other than that shown in this Executive Order or marketing of this device for an application other than those listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board. Exemption of a kit shall not be construed as an exemption to sell, offer for sale or advertise any component of a kit as an individual device.

This Executive Order does not constitute any opinion as to the effect that the use of this device may have on any warranty either expressed or implied by the vehicle manufacturer.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF THE HYDROPOWER WATER INJECTION SYSTEM.

No claim of any kind, such as "Approved by Air Resources Board" may be made with respect to the action taken herein in any advertising or other oral or written communication.

Section 17500 of the Business and Professions Code makes untrue or misleading advertising unlawful, and Section 17534 makes violation punishable as a misdemeanor.

Section 43644 of the Health and Safety Code provides as follows:

> "43644. (a) No person shall install, sell, offer for sale, or advertise, or, except in an application to the state board for certification of a device, represent, any device as a motor vehicle pollution control device for use on any used vehicle unless that device has been certified by the state board. No person shall sell, offer for sale, advertise, or represent any motor vehicle pollution control device as a certified device which, in fact, is not a certified device. Any violation of this subdivision is a misdemeanor."

Any apparent violation of the conditions of this Executive Order will be submitted to the Attorney General of California for such action as he deems advisable.

Executed at El Monte, California, this 30th day of ~~March~~, 1983.

K. D. Drachand, Chief
Mobile Source Control Division

Issue Date: March 3, 1983

EVALUATION OF THE PATRON INCORPORATED'S HYDROPOWER WATER INJECTION SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE

by

Mobile Source Control Division
State of California
Air Resources Board
9528 Telstar Avenue
El Monte, CA
91731

State of California
AIR RESOURCES BOARD

EVALUATION OF THE PATRON INCORPORATED'S HYDROPOWER WATER INJECTION SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE

March 3, 1983

SUMMARY

PatRon Incorporated of Elkhart, Indiana, applied for exemption from the prohibitions in Section 27156 of the California Vehicle Code for their "Hydropower Water Injection System" device. The applicant has requested that exemption be granted for all vehicles equipped with carbureted gasoline engines.

Two-1981, one-1982, and one-1983, model-year vehicles were used for the evaluation of this device. The vehicles were tested using back-to-back (baseline and with-device) CVS-75 and Highway Fuel Economy Test (HFET) procedures. Bench flow tests were performed for determining the maximum flow rates of the device.

The test data on the original device showed the following:

1. The CVS-75 test results indicate that the Hydropower device, when set to the manufacturer's specifications, will have little effects on emissions from the test vehicles.

2. These CVS-75 and HFET tests also show that the device has little effect on fuel economy of the test vehicle(s).

3. The test data also show that the device, when operating under the worst case condition (maximum flow), will cause an increase in HC emissions from a small-size engine.

The applicant modified the control head with a flow limiter and submitted it to the staff for an engineering evaluation. The bench flow test data on the modified device show that the flow permitted by the preset spring loaded check valve in conjunction with the adjustable flow control valve and air bleed meets the Board's evaluation criteria, and would not increase emissions under worst case conditions.

Based upon the modified "Hydropower Water Injection System" device bench flow test data, the staff recommends that the Board exempt the device from the prohibitions in Vehicle Code Section 27156 by adopting Executive Order D-125.

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EVALUATION OF THE PATRON INCORPORATED'S HYDROPOWER WATER INJECTION SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE.

I. INTRODUCTION

PatRon Incorporated of Elkhart, Indiana, submitted an application for exemption from the prohibitions in Section 27156 of the California Vehicle Code for the company's "Hydropower Water Injection System" device. Vehicle Code Section 27156 prohibits the installation of any device or mechanism which reduces the effectiveness of the required emission control system. This Code also authorizes the Air Resources Board to exempt a device from this prohibition if it can be demonstrated that the device, upon installation on the engine, will not adversely affect the performance of the existing emission control system. The applicant has requested that the exemption be granted for the installation of this device for all vehicles equipped with carbureted gasoline engines.

II. CONCLUSION

The staff evaluated the device and found no evidence to show that the "Hydropower Water Injection System" device with the modified control head will have significant adverse effect(s) on emissions from motor vehicles. The test data also show that this device will have little effect on fuel economy. The company has agreed to remove unsubstantiated fuel economy claims from the company's letterhead and all advertisements in California.

III. RECOMMENDATION

Based on the test data and the submitted information, the staff recommends that the Board exempt the "Hydropower Water Injection System" device from the prohibitions in Vehicle Code Section 27156. The staff, therefore, recommends the adoption of Executive Order D-125.

IV. SYSTEM DESCRIPTION AND OPERATION

The "Hydropower Water Injection System" device (Figure 1) is designed to be connected to the engine intake manifold through a tee connection in the hose line between the positive crankcase ventilation (PCV) valve and the carburetor. The device is a combination of water injection and air bleed. It consists of a plastic water reservoir, two plastic hoses (3/8" diameter and 3/16" diameter), a plastic tee, five (5) plastic mounting straps, and a control head.

The control head consists of a vacuum gauge, a transparent plastic tube flow indicator, and a mixing chamber. The 2" (diameter) by 1/2" (high) mixing chamber of about 1.5 cu. in. capacity is the heart of this device. It has two inlet ports and two outlet ports. Through plastic tubes, one outlet port is connected to the vacuum gauge and the other is connected to the PCV line of the engine. One of the inlet ports is open to the atmosphere for air bleed into the mixing chamber through a piece of packed foam rubber filter. The other inlet port is fitted with a spring loaded ball valve which serves as a check valve to allow water from the reservoir to flow into the mixing chamber only under high vacuum engine operating conditions. A control knob mounted in front of the control head (integral part of the chamber) can be turned from zero to six equal graduations. The control knob has a threaded stem with a tapered tip that moves forward or backward when the knob is turned to regulate or stop the flow of water into the chamber.

The amount of water injection is a function of engine intake manifold vacuum and the inlet port opening as set by the flow control knob. Maximum flow rate is obtained under high manifold vacuum engine operating

conditions (such as idle, low speed cruises, and deceleration) and large valve opening (knob position 6). Little or no water injection occurs at low manifold vacuum. The proper flow control setting is to be done by the driver of the vehicle. The higher the control knob position number, the more water is fed to the engine. According to the operating instructions, the control knob setting varies according to the engine displacement and the vehicle operating conditions. Flow control knob positions #1 and #2 are suitable for most vehicle engine applications as recommended by the manufacturer. The amount of air bled into the PCV line is not controlled by the control knob, it is controlled by the engine intake manifold vacuum through the PCV line. The air/water mixture from the mixing chamber then passes through the flow indicator and the tee connection into the PCV line.

V. EMISSION AND FUEL ECONOMY TEST

The test vehicles selected were popular or representative models for performance evaluation of aftermarket add-on devices. The test vehicle was inspected and road tested to assure that it was in good operating condition for emissions testing.

The comparative emissions and fuel economy tests (baseline versus with-device tests) were conducted in accordance with the cold-start CVS-75 and Highway Fuel Economy Test (HFET) procedures. The baseline tests were run with the vehicle engine set to vehicle manufacturer's specifications.

Three series of with-device tests were performed by the Air Resources Board. The first series subjected the device to CVS-75 and Highway Fuel Economy Test (HFET) procedures using a 1981 Ford Fairmont, with a straight-six, 200 CID engine, and a three-speed automatic transmission. The with-device tests were run with the device installed and adjusted according to the device manufacturer's written instructions.

A 1981 Chevrolet Monte Carlo, with a V-6, 231 CID engine and a three-speed automatic transmission, was used for the second series of tests. Again, the device was installed and adjusted according to the device manufacturer's written instructions and CVS-75 and HFET's were performed.

The third test series of CVS-75 and HFET were performed using two (2) test vehicles: a 1982 Chevrolet Chevette, with an I-4, 98 CID engine equipped with a three-speed automatic transmission, and a 1983 Chevrolet Caprice with a V-8, 305 CID engine equipped with a four (4)-speed automatic transmission. These tests were conducted to evaluate the effect of the device on exhaust emission under the worst device operating conditions - maximum water flow and no water flow.

The descriptions of the four test vehicles are shown below:

Test Vehicle Description	Vehicle No. 1	Vehicle No. 2	Vehicle No. 3	Vehicle No. 4
Make	Ford Fairmont	Chevrolet Monte Carlo	Chevrolet Chevette	Chevrolet Caprice
Model-Year	1981	1981	1982	1983
Engine Size (CID)	I-6 200	V-6 231	I-4 98	V-8 305
Carburetor	2-BBL	2-BBL	2-BBL	4-BBL
Transmission	3-Speed Automatic	3-Speed Automatic	3-Speed Automatic	4-Speed Automatic
Emission Controls:	All with EGR, AIP, TWC, and CL.			

VI. TEST RESULTS

The test results are shown in the following tables:

Table 1

1981 Ford Fairmont

Cold-Start CVS-75 Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.32	2.36	0.73	16.60
Baseline	0.33	2.76	0.69	16.60
Average	0.33	2.56	0.71	16.60
Device Test	0.50	2.48	0.72	16.40

Hot-Start HFET Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.08	0.18	0.99	22.20
Baseline	0.10	0.15	0.84	22.30
Average	0.09	0.17	0.92	22.25
Device Test	0.12	0.19	1.07	22.00

Table 2

1981 Monte Carlo

Cold-Start CVS-75 Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.35	5.51	0.63	18.3
Baseline 2	0.35	4.94	0.74	18.4
Average	0.35	5.23	0.69	18.4
Device Test 1	0.37	5.50	0.67	18.5
Device Test 2	0.35	5.12	0.72	18.4
Average	0.36	5.31	0.70	18.5

Hot-Start HFET Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.03	0.74	0.32	27.0
Baseline 2	0.04	0.55	0.53	26.8
Average	0.04	0.65	0.43	26.9
Device Test 1	0.04	0.76	0.34	27.1
Device Test 2	0.04	0.86	0.41	27.3
Average	0.04	0.81	0.38	27.2

Table 3

1982 Chevy Chevette

Cold-Start CVS-75 Test

Test Condition*	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.14	1.33	0.43	31.30
Baseline 2	0.17	2.74	0.52	26.30
Baseline 3	0.14	2.45	0.56	27.10
Average	0.15	2.17	0.50	28.23
A				
Device Test 1	0.18	1.84	0.43	26.20
Device Test 2	0.19	2.56	0.51	25.50
Device Test 3	0.18	2.24	0.53	25.80
Device Test 4	0.23	2.59	0.47	26.00
Average	0.20	2.31	0.49	25.88
B				
Device Test 1	0.28	2.34	0.38	24.40
Device Test 2	0.22	2.04	0.46	25.20
Device Test 3	0.22	2.17	0.40	24.60
Average	0.24	2.18	0.41	24.73

* Test Condition:

A - Device flow control knob completely closed (passed zero on the dial).

B - Device flow control knob fully open (more than three complete turns).

Hot-Start HFET Test

Test Condition*	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.05	0.06	0.16	36.60
Baseline 2	0.05	0.10	0.16	34.00
Baseline 3	0.04	0.22	0.19	35.20
Average	0.05	0.13	0.17	35.27
A				
Device Test 1	0.05	0.07	0.21	33.60
Device Test 2	0.05	0.07	0.18	33.70
Device Test 3	0.05	0.06	0.19	33.90
Device Test 4	0.08	0.09	0.15	34.90
Average	0.06	0.07	0.18	34.03
B				
Device Test 1	0.11	0.12	0.13	33.80
Device Test 2	0.11	0.11	0.36	--
Device Test 3	0.06	0.10	0.15	34.50
Average	0.09	0.11	0.21	34.15

* Test Condition:

A - Device flow control knob completely closed (passed zero on the dial).

B - Device flow control knob fully open (more than three complete turns).

Table 4

1983 Chevy Caprice

Cold-Start CVS-75 Test

Test Condition*	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.28	4.50	0.50	15.80
Baseline 2	0.23	4.44	0.50	15.60
Baseline 3	0.36	6.60	0.42	15.40
Baseline 4	0.35	5.68	0.51	15.60
Average	0.31	5.31	0.48	15.60
A_1				
Device Test 1	0.25	4.13	0.45	15.10
Device Test 2	0.33	5.49	0.49	15.30
Device Test 3	0.35	4.96	0.43	15.20
Average	0.31	4.86	0.46	15.20
B				
Device Test 1	0.25	4.97	0.47	15.40
Device Test 2	0.35	5.75	0.44	15.20
Device Test 3	0.30	5.41	0.45	15.50
Average	0.30	5.38	0.45	15.37

* Test Condition:

A_1- Device flow control knob set to #2 (plus) position.

B - Device flow control knob fully open (more than three complete turns).

Hot-Start HFET Test

Test Condition*	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline 1	0.03	1.36	0.14	25.40
Baseline 2	0.04	1.72	0.20	25.00
Baseline 3	0.04	1.60	0.14	25.20
Baseline 4	0.05	2.26	0.21	25.10
Average	0.04	1.74	0.17	25.18
A_1				
Device Test 1	0.05	2.02	0.26	24.40
Device Test 2	0.07	2.27	0.44	25.00
Device Test 3	0.06	2.08	0.39	25.20
Average	0.06	2.12	0.36	24.87
B				
Device Test 1	0.07	1.98	0.36	25.10
Device Test 2	0.06	2.20	0.39	25.20
Device Test 3	0.12	1.90	0.26	25.20
Average	0.08	2.03	0.34	25.17

* Test Condition:

A_1- Device flow control knob set to #2 (plus) position.

B - Device flow control knob fully open (more than three complete turns).

VII. DISCUSSION OF TEST RESULTS

The applicant submitted several customer testimonials; however, no laboratory emission and fuel economy test data were submitted for evaluation.

The results of the first test series on the Ford Fairmont showed an increase in HC emissions with the use of the device. However, since the with-device test data were from only one valid test, while the baseline data were averages from two (2) tests, the comparison was not conclusive. A second test series using a second car, a 1981 Monte Carlo, was therefore performed.

Although the results from the second test series showed minimum effect on emissions, the manner in which the water flow of this device is regulated caused concerns. There is a tendency that the flow adjustment knob may become loose or be adjusted to allow excess water flow into the engine. To simulate this worst case situation, a third test series was performed using two test vehicles, a 1982 Chevette with a 98 CID engine and a 1983 Caprice with a 305 CID engine.

In the third test series with the device set according to the manufacturer's specifications, the test data show no adverse effects on emission. The increase of average HC emission by 0.05 g/mi for the Chevrolet Chevette may be considered insignificant.

The worst case test results from the Chevrolet Caprice with a large-size engine (305 CID) showed minimum effect on emissions with the use of the device. The results from the Chevrolet Chevette with a small-size engine (98 CID), however, indicated an increase in HC emissions. To avoid excess flow of water into the vehicle engine (for small-size engine application), the applicant agreed and modified the control head. A sample of the modified

APPENDIX

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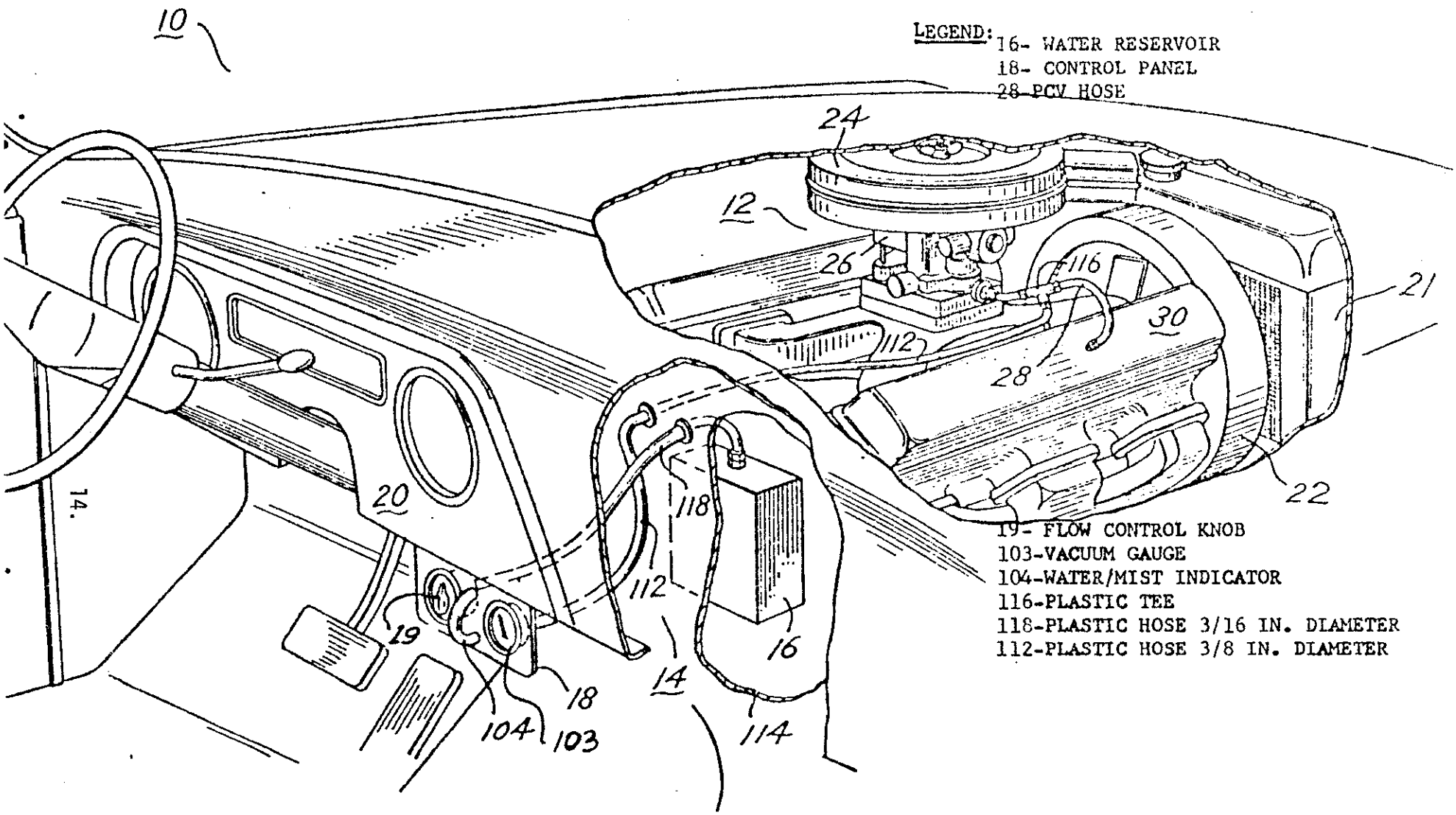
Fig. 1

HYDROPOWER WATER INJECTION SYSTEM DEVICE
INSTALLATION DIAGRAM



LEGEND:
16- WATER RESERVOIR
18- CONTROL PANEL
28-PCV HOSE
19- FLOW CONTROL KNOB
103-VACUUM GAUGE
104-WATER/MIST INDICATOR
116-PLASTIC TEE
118-PLASTIC HOSE 3/16 IN. DIAMETER
112-PLASTIC HOSE 3/8 IN. DIAMETER

DIAGRAM