Exhaust Emissions From Controlled and Uncontrolled Vehicles Using the "Pollution Master" Emission Control Device

August 1971

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ENVIRONMENTAL PROTECTION AGENCY

Background

The exhaust emission characteristics of the "Pollution Master" device on both controlled and uncontrolled vehicles have been requested by Congressional, Federal, and State sources requiring a repeat of the tests run in 1969 on a Post Office vehicle (Appendix A).

Device

The uncontrolled vehicle used for this most recent test was a Government-owned 1963 Chevrolet V-8 with a manual transmission. The device used on this vehicle was supplied by Pollution Master of Kentucky-Tennessee and was installed by Government employees using the instructions furnished with the kit. The controlled vehicle used for this test was supplied by the Louisville Courier-Journal and was a 1968 Ford Falcon. This vehicle used a 200 cubic-inch six cylinder engine and manual transmission. The device installation was carried out by an outlet selling "Pollution Master" in Louisville, Kentucky. It is assumed that this installation, which was paid for by the newspaper, was a typical installation and was representative.

The "Pollution Master" is a two part system containing an "exhaust scavenger" and a "crankcase scavenger". The exhaust scavenger is a pipe with a one-way valve that is connected to the exhaust through holes that must be drilled and tapped into the exhaust manifold. Under any condition of low pressure in the manifold, air will be drawn through a valve and filter from the engine compartment into the manifold. The crankcase scavenger is a large diameter tube containing plates with drilled holes to allow air passage and a filter. This unit is installed in the positive crankcase ventilation (PCV) line with the interior working parts of the PCV removed. This allows an increase in air flow at idle as there is no idle restriction in the crankcase scavenger as is normally found in the PCV system. The total effect of this device is to admit additional air to the manifold thus providing a leaner fuel-air mixture to the engine. Some air is also admitted to the exhaust manifold thus diluting the exhaust.

In the Government installation of the "Pollution Master" the only portion of the emission control system disconnected was the PCV valve as required in the instructions. On the vehicle converted by "Pollution Master" the PCV valve was disconnected and the heat stove that supplies warm air to the carburetor was cut into to provide clearance for the device. The effect of this change in the system is unknown but considered minimal.

One advertised purpose of the system is: "To meet and exceed existing standards for automotive emission control."

Test Program

For evaluation purposes the Federal emission test procedures for certification of new cars for 1971 and the procedure for 1972 certification were used. The 1971 test is the open cycle 7-mode test using infrared (NDIR) instruments as specified in the Federal Register. In addition a continuous NDIR NO analyzer was used. The Federal standards for new vehicles using the 1971 test procedure are HC=2.2 grams per vehicle mile (gpm) and CO=23 gpm. There is no Federal standard for NO_2. The 1972 test uses the closed, self-weighting constant volume sampling technique for sample collection and the exhaust is analyzed using a flame ionization detector for hydrocarbons, NDIR for CO and CO_2, and chemiluminscence for oxides of nitrogen. The Federal standards for new vehicles using the 1972 test procedure are HC=3.4 gpm and CO=39 gpm. A standard for NO_2=3 gpm has been set for 1973 vehicles. The vehicle was tested alternately with "Pollution Master" installed and with the vehicle returned to original condition. In addition, fuel was weighed on three of the tests using the 1968 Falcon to determine any fuel economy effect.

Results

The data shown in Table I compares the 1963 Chevy with the "Pollution Master" device to the same vehicle without the device using the 1972 test procedure. In this table the results are listed in the order that the tests were run. The first two tests were run with "Pollution Master" installed, the next four with "Pollution Master" removed, the next four with "Pollution Master" re-installed and the last four with "Pollution Master" removed. There appears to be a slight reduction of CO and HC with the "Pollution Master" although the values vary considerably.

Table II shows the results from "Pollution Master" and the baseline tests on the 1968 Falcon using the 1972 test procedure. As on the Chevrolet there appears to be a slight reduction in emissions from "Pollution Master" although again the results are so varied that a percentage reduction cannot be accurately calculated.

Table III compares the 1968 Falcon with and without "Pollution Master" using the 1971 test procedure. These results show a more consistent improvement in emissions with "Pollution Master". However, it should be remembered that this obsolete test procedure was dropped as being a less meaningful way of measuring exhaust emissions.

Conclusions

1. "Pollution Master" emission reductions using the latest test procedures are minimal.

2. Equivalent results could be obtained by using a very lean idle setting as shown in the GM retrofit report #71-2.

3. There was no fuel economy improvement observed with "Pollution Master" in our limited tests.

Table I

1972 Federal Emission Tests

1963 Chevrolet V-8, Manual Transmission
All Results in Grams Per Mile

HC FID	CO NDIR	CO_2 NDIR	NO_2 CI
Pollution Master Tests			
7.4	99	451	---
7.5	94	497	---
Stock Vehicle Baseline Tests			
9.8	103	446	---
8.5	108	454	---
8.2	98	437	---
8.4	96	465	---
Pollution Master Tests			
6.7	81	446	---
8.5	88	394	1.3
5.9	83	434	1.8
7.2	88	434	1.2
Stock Vehicle Baseline Tests			
7.0	95	403	1.3
7.8	99	439	1.9
13.1	43	464	2.3
7.6	79	448	1.8

Table III

1971 Federal Emission Tests

1968 Falcon 6 Manual Transmission
All Results in Grams Per Mile

HC IR	CO IR	NO IR
Pollution Master Tests		
2.3	24	3.9
Stock Vehicle Baseline Tests		
2.8	29	3.7
3.2	29	4.1

Table II

1972 Federal Emission Tests

1968 Falcon 6,Manual Transmission
All Emission Results in Grams Per Mile

HC FID	CO NDIR	CO_2 NDIR	NO_2 CI	Fuel Used KG
		Pollution Master Tests		
3.6	38	434	7.2	1.7
2.6	24	472	5.4	
3.1	25	509	6.6	1.9
		Stock Vehicle Baseline Tests		
3.6	32	410	5.2	1.6
3.3	37	479	5.7	

Memorandum

National Air Pollution Control Administration
Bureau of Abatement and Control
Division of Motor Vehicle Pollution Control

TO : Chief, Emission Control Evaluation Branch DATE: February 27, 1969

THROUGH: Chief, Emission Control Evaluation Section

FROM : Senior Sanitary Engineer, ECES

SUBJECT : "Pollution Master" Device - Evaluation on a Post Office Vehicle

At the request of NAPCA and the Post Office Department (P.O.D.) the "Pollution Master System" has been evaluated for control of exhaust emissions. Pollution Master is manufactured by Automotive Emissions Control Corp. (AEC) of Louisville, Kentucky. The system consists of two parts: one, a replacement for the "PCV" valve, which regulates the flow of crankcase blowby gases by a "Venturi" principle; and the other is a one-way valve which allows air to enter the exhaust manifold during moments when the pressure there is below atmospheric.

Mr. Jim Patton, Mr. Tony Leone, and Mr. Ron Daley of AEC were in attendance throughout the testing except for the rerun of the final baseline. NAPCA was represented by the author and Mr. H.A. Ashby. Work at the Ann Arbor Post Office Garage was coordinated by Mr. George Porter of P.O.D.

On Monday, February 3, 1969, Mr. Ashby and I met with the representatives of AEC at the Post Office Garage in Ann Arbor to inspect the vehicle and to obtain some preliminary data. The P.O.D. vehicle was a 1967 Ford Fairlane station wagon equipped with a 200 CID, 6 cylinder engine and automatic transmission.

The vehicle had approximately 37,000 miles at the start of our tests. In regular service, this vehicle is used for special deliveries, so that the mileage is accumulated under widely varying conditions. Post Office records showed the following recent maintenance:

At 29,514 miles - new spark plugs
30,942 miles - tune-up to spec's
Idle Speed: 500 rpm - drive
Dwell: 38°
Basic Timing: 5° BTC
Spark Adv: 42°
A/F (Sun Instr.): 14.0/1
35,148 miles (12-31-68) - new ignition points
36,488 miles (1-23-69) - new spark plug wires

The following information was obtained on this initial inspection:

Idle Speed: 540 rpm - drive
(Sun Instr) A/F: 13.2/1

Compression Pressure (2)				Spark Plug Gap
Cyl. No.	1	173 psi		.035" (3)
Cyl. No.	2	160 "		.035
" "	3	170 "		.035 (1)
" "	4	130 "	, check 135	.036
" "	5	178 "		.035
" "	6	130 "	, check 150	.036

The original test sequence called for two emission baselines to bracket the performance with the device installed. The vehicle was at that time tested in the "as received condition". After the emissions test, the engine was run for an additional two hours withthe device installed. Cylinder compression was then checked, with the following results:

Cyl. No.	1	175 psi
" "	2	165 "
" "	3	175 "
" "	4	175 "
" "	5	175 "
" "	6	165 "

Note the compression increase on cylinders 4 and 6 when compared to initial compression check. AEC personnel felt this was due to the cleaning effect of their device. There is the possibility, however, that the hydraulic valve lifters might have been sticking at the cranking speeds. AEC personnel objected to this test sequence, since they felt it did not allow time for mileage accumulation with the device installed. They also felt this was necessary in order to demonstrate the device's maximum effectiveness. Two other events, however, cast doubt on the value of the data obtained in this first sequence. First, the vehicle had a persistent intermittent misfire which was due to neither the spark plugs nor the emissions control device. Second, and most important, there was a leak in the tubing connecting the "Pollution Master" crankcase ventilation system to the intake manifold which leaned the mixture out significantly. This leak was not detected until the second installation of the device. The data from these first three tests are included in Tables I (Data by 1968 Procedure) and II (Data by 1970 Procedure).

Post Office and NAPCA personnel decided that a second series of tests was necessary with the misfire cured, which included provision for mileage accumulation with the device installed. This new test series was discussed with the AEC representatives. Mr. Patton indicated they would be happy if they could have the car for one (1) day rather than allow the vehicle to accumulate the mileage in normal post office usage. A compromise was reached. AEC personnel would have the vehicle for one (1) day (Saturday)

(1) This spark plug had very heavy deposits
(2) 20 psi allowable variation (FOMOCO)
(3) This spark plug had a cracked porcelain and was replaced with a new one

and the following day the vehicle would go into normal post office service. AEC personnel also requested that they be allowed to adjust the idle air-fuel ratio (A/F) to approximately 14.0/1 which is where their system was optimized. This was granted. The new test sequence was:

1. A new baseline with the misfire cured and the engine operating to everyone's satisfaction.
2. A test with the device installed and the A/F adjusted to approximately 14.0/1 to AEC's satisfaction.
3. A second test with device installed after mileage accumulation, as discussed.
4. A final baseline without the device, but with the same A/F as when the device was installed.

In order to cure the misfire and put the engine in proper operating condition the following maintenance was performed:

Installed new: Carbon core spark plug wires
distributor cap
vacuum advance mechanism
air filter
ignition points

The distributor was disassembled, cleaned and set to specifications. Idle A/F was checked but not adjusted. All this was performed under the supervision of Mr. Porter of the Post Office Department. The vehicle was now in proper operating condition with no misfire. Except for the number one spark plug, the original spark plugs were left in the engine. With the vehicle in this condition, the new baseline emissions test was run. The device was then installed. At this point the leak was detected and all new hoses were installed to correct it. The idle A/F was set at approximately 14.0/1 to the satisfaction of AEC personnel, and tested in this condition. Mileage was accumulated as discussed earlier, after which the A/F and idle speed were checked and found to be as set previously. The number 3 spark plug was examined and the heavy deposit noted earlier had apparently been removed during operation with the device installed. The second emissions test with the device was performed. The device was then removed and the A/F set to approximately 14.0/1. During the final baseline test the engine stalled at idle voiding the test. Since AEC had an agreement with P.O.D. to install the device after the testing was completed, AEC insisted that the car be returned to the P.O. Garage for the reinstallation. As far as they were concerned the testing was completed. The vehicle was then returned to the P.O. where the spark plugs were changed, the carburetor float level reset and a new needle valve installed. The oil and oil filter were also changed. After this the vehicle went back into service for the rest of the day and evening. The following day NAPCA personnel picked up the vehicle, removed the device, adjusted the A/F to that measured with the device installed and reran the final baseline emissions test. This final test was to represent the kind of emissions level this engine is capable of at 37,000 miles when carefully tuned and the carburetor in good working order. This then could be compared to the emissions level obtainable with the $35 to $40 Pollution Master device installed. Unfortunately this last test is not really representative because on the idle portion of the last cycle the engine suddenly got rough and the idle hydrocarbon level increased sharply (see Figure 7, cycles 6 and 7), while CO remained essentially the same. This suggests a misfire or perhaps a stuck valve. In any case, the resultant Hot Cycle and composite hydrocarbon numbers are higher than we feel is representative. The Cold Cycle hydrocarbon level is representative and indicates that the engine is capable of equalling the hydrocarbon level and, more assuredly, the CO level obtained with the device installed.

During this testing neither the author nor Mr. Ashby detected an appreciable difference in driveability of the vehicle with or without the device, although Mr. Porter of P.O.D. apparently felt it was improved somewhat with the device installed.

In summary, it appears that the device may have a small beneficial effect on exhaust emissions on this particular vehicle. However, by tuning the engine with low emissions in mind (lean carburetion) the reduction due to the device becomes marginal.

Michael A. Caggiano

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Attachments

TABLE II

"Pollution Master" Device Evaluation

on a Post Office Vehicle

Test No.	Conditions	Device	Composite No. HC $\frac{\text{Grams}}{\text{Miles}}$	CO $\frac{\text{Grams}}{\text{Miles}}$
	First Series of Tests			
1	As received baseline	without	3.96	32.9
2	As received	with	4.01	8.1
3	Baseline	without	3.60	30.2
	Second Series of Tests			
4	Tuned-up baseline	without	4.08	30.0
5	With A/F adjusted to 14.0/1	with	3.51	21.7
6	After mileage accumulation	with	3.23	16.6
7	Baseline with A/F to 14.0/1	without	3.88	18.0
	1970 Federal Standards are		2.2	23

TABLE I

"Pollution Master" Device Evaluation on a Post Office Vehicle

Conditions	Device	Cold Cycle		Hot Cycle		Composite	
First Series of Tests		HC	CO	HC	CO	HC	CO
(1) As received baseline	without	352	1.69	328	1.28	337	1.42
(2) As received	with	363	0.58	379	0.28	374	0.38
Baseline	without	324	1.55	297	1.17	307	1.30
Second Series of Tests							
(3) Tuned-up baseline	without	372	1.50	338	1.20	350	1.31
With A/F adjusted to 14.0/1	with	334	1.25	294	0.83	308	0.98
After mileage accumulation	with	293	1.10	281	0.57	285	0.76
Baseline with A/F at 14.0/1	without	325	1.17	353	0.63	343	0.82

(1) Vehicle had misfire which was not corrected during the first series of tests. #1 spark plug was changed at the initial inspection of the vehicle. The rest of the spark plugs remained in throughout both test series.

(2) Subsequent to this test, a leak was found in the PCV Tubing of the Pollution Master device which allowed air to enter the intake manifold and lean out the mixture.

(3) Misfire was corrected and the ignition system was put in proper operating condition. Still using the original spark plugs. A/F was unchanged from first series of tests.

FIGURE 1

2-1447 02-04-69 FAIRLANE STWGN 720408 37060 MILES 3500#

EXPERIMENTAL (BASELINE W/0 DEVICE)

SUM	CYCLES 1-4			CYCLES 6-7	
354.7851	1.7504	13.1899	328.5572	1.2767	13.6681
TØTAL WEIGHTED SUM			337.7370	1.4425	13.5007

HC	CØ	CØ2	FACTØR	WHC	WCØ
473.9	9.87	8.47	.82	16.3	.34
423.4	4.31	11.67	.94	96.9	.99
325.5	3.98	12.20	.93	35.6	.44
694.1	9.35	8.79	.81	34.8	.47
394.1	5.29	11.60	.89	17.5	.23
305.8	.80	13.69	1.04	144.0	.38
3288.7	6.15	7.81	.94	89.8	.17
TØTAL CYCLE 1		434.9 PPM HC	3.01 CØ	11.91 CØ2	
417.1	5.84	11.23	.88	15.4	.22
283.2	.99	11.91	1.16	80.4	.28
187.1	.16	12.37	1.20	26.4	.02
443.3	5.95	10.27	.91	25.0	.34
304.8	2.64	13.32	.94	14.3	.12
193.0	.31	11.93	1.23	107.6	.17
2629.3	4.97	8.94	.97	73.9	.14
TØTAL CYCLE 2		343.0 PPM HC	1.29 CØ	13.65 CØ2	
442.3	6.56	10.77	.87	16.1	.24
290.4	.98	12.42	1.12	79.3	.27
193.0	.18	12.67	1.17	26.6	.02
354.5	5.00	11.07	.92	20.2	.29
291.4	2.65	13.40	.93	13.6	.12
170.2	.33	12.37	1.18	91.4	.18
2259.5	4.70	9.28	.98	64.1	.13
TØTAL CYCLE 3		311.3 PPM HC	1.25 CØ	13.70 CØ2	
424.4	6.51	10.86	.86	15.4	.24
274.0	.94	12.50	1.12	74.6	.26
184.1	.19	12.65	1.17	25.4	.03
461.2	4.82	11.00	.93	26.7	.28
287.3	2.31	13.47	.95	13.7	.11
188.1	.32	12.37	1.18	101.1	.17
2203.7	4.70	9.41	.97	62.1	.13
TØTAL CYCLE 4		318.9 PPM HC	1.21 CØ	13.73 CØ2	
381.5	6.30	10.82	.88	14.0	.23
280.2	1.16	12.65	1.09	74.2	.31
176.1	.25	13.19	1.12	23.2	.03
506.7	4.91	10.86	.93	29.3	.28
275.0	2.46	13.32	.95	13.1	.12
205.1	.31	12.55	1.17	108.8	.17
2093.3	4.63	9.17	1.00	60.5	.13
TØTAL CYCLE 6		323.1 PPM HC	1.27 CØ	13.67 CØ2	
397.2	6.06	11.00	.88	14.7	.22
285.3	.99	12.72	1.09	76.1	.26
199.0	.23	13.42	1.10	25.8	.03
518.4	4.88	11.02	.93	29.7	.28
277.1	3.09	13.08	.93	12.9	.14
208.1	.39	12.47	1.17	110.4	.20
2231.6	4.62	9.13	.99	64.3	.13
TØTAL CYCLE 7		334.0 PPM HC	1.28 CØ	13.66 CØ2	

AVERAGE ØF CYCLES 1-4	352.0 PPM HC	1.69 CØ	13.25 CØ2
AVERAGE ØF CYCLES 6-7	328.5 PPM HC	1.28 CØ	13.67 CØ2
WEIGHTED SUM	336.8 PPM HC	1.42 CØ	13.52 CØ2

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FIGURE 2

2-1448 02-05-69 FØRD FAIRLANE STWGN 720408 37083 MILES 3500#

EXPERIMENTAL PØLLUTIØN MASTER EVALUATIØN

SUM	CYCLES 1-4			CYCLES 6-7	
359.0629	.6214	14.2848	379.2561	.2765	14.6118
TØTAL WEIGHTED SUM		372.1885		.3972	14.4973

HC	CØ	CØ2	FACTØR	WHC	WCØ	
204.1	.93	13.21	1.06	9.1	.04	
278.1	1.75	13.06	1.01	68.8	.43	
276.1	2.39	13.34	.95	31.1	.27	
277.1	4.69	11.27	.93	16.0	.27	
262.8	1.80	13.21	1.00	13.1	.09	
222.2	.34	13.55	1.08	109.1	.17	
2619,7	2.02	9.17	1.17	89.2	.07	
TØTAL CYCLE 1		336.4	PPM HC	1.34 CØ	13.60	CØ2
218.1	.48	12.13	1.19	10.9	.02	
186.1	.29	12.15	1.21	54.7	.08	
149.5	.15	12.03	1.23	21.7	.02	
822.7	.82	10.82	1.24	63.0	.06	
247.5	.26	13.13	1.12	13.9	.01	
154.4	.19	12.30	1.20	84.4	.10	
2381,3	1.05	9.19	1.28	88.7	.04	
TØTAL CYCLE 2		337.4	PPM HC	.35 CØ	14.56	CØ2
279.1	.29	11.93	1.23	14.4	.02	
206.1	.28	12.55	1.17	58.8	.08	
149.5	.18	12.06	1.23	21.6	.03	
1246.3	.50	10.29	1.30	100.4	.04	
181.1	.34	13.00	1.12	10.2	.02	
144.6	.21	12.55	1.18	77.4	.11	
2362,5	.77	8.66	1.38	94.8	.03	
TØTAL CYCLE 3		377.5	PPM HC	.32 CØ	14.56	CØ2
367.0	.29	11.60	1.26	19.5	.02	
227.2	.27	12.57	1.17	64.8	.08	
156.4	.18	12.15	1.22	22.4	.03	
1271.3	.44	10.32	1.30	102.7	.04	
198.0	.28	13.00	1.13	11.2	.02	
164.2	.20	12.30	1.20	89.7	.11	
2268.8	.76	8.72	1.38	91.0	.03	
TØTAL CYCLE 4		401.2	PPM HC	.31 CØ	14.58	CØ2
346.2	.18	11.60	1.27	18.5	.01	
214.1	.25	12.50	1.18	61.5	.07	
141.6	.16	12.20	1.21	20.3	.02	
1163.6	.42	10.25	1.32	95.2	.03	
243.6	.27	12.78	1.15	14.0	.02	
135.8	.17	12.30	1.20	74.3	.09	
2185,3	.68	8.76	1.39	88.4	.03	
TØTAL CYCLE 6		372.2	PPM HC	.28 CØ	14.61	CØ2
295.6	.23	11.84	1.24	15.4	.01	
217.1	.23	12.47	1.18	62.5	.07	
157.3	.17	12.30	1.20	22.3	.02	
1221.5	.41	10.25	1.32	99.7	.03	
186.1	.24	12.95	1.14	10.6	.01	
158.3	.18	12.30	1.20	86.6	.10	
2185,3	.68	8.66	1.41	89.3	.03	
TØTAL CYCLE 7.		386.4	PPM HC	.28 CØ	14.61	CØ2

AVERAGE ØF CYCLES 1-4	363.1 PPM HC	.58	CØ	14.32	CØ2
AVERAGE ØF CYCLES 6-7	379.3 PPM HC	.28	CØ	14.61	CØ2
WEIGHTED SUM	373.6 PPM HC	.38	CØ	14.51	CØ2

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FIGURE 3

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2-1451 02-06-69   FØRD FAIRLANE STWGN      720408       37195 MILES  3500#
E XPERIMENTAL BASELINE TWØ WITH ØUT DEVICE

 SUM              CYCLES 1-4                               CYCLES 6-7
   327.2891       1.6105   13.3306          297.4538      1.1721    13.7738
          TØTAL WEIGHTED SUM      307.8962            1.3255          13.6187

  HC       CØ       CØ2      FACTØR   WHC      WCØ
  30.7     .63      1.56     6.84      8.8     .18
 372.2    3.37     12.28      .96     87.1     .79
 306.9    3.81     12.30      .93     33.7     .42
 910.1    9.03      8.61      .82     46.5     .46
 279.1    5.83     11.11      .89     12.4     .26
 258.7     .78     13.53     1.05    123.4     .37
3569.1    5.33      7.88      .98    101.1     .15
 TØTAL CYCLE 1     413.1 PPM  HC 2.63 CØ 12.28 CØ2
 416.0    6.51     10.69      .87     15.2     .24
 277.1     .95     11.91     1.17     78.9     .27
 229.2     .16     12.50     1.19     32.1     .02
 403.5    5.67     10.55      .91     22.8     .32
 275.0    2.48     13.32      .95     13.1     .12
 166.2     .27     11.89     1.23     93.4     .15
1957.0    4.79      9.69      .96     54.4     .13
 TØTAL CYCLE 2     309.7 PPM  HC 1.25 CØ 13.70 CØ2
 367.0    6.05     11.04      .88     13.5     .22
 241.4     .84     12.32     1.14     67.1     .23
 172.1     .18     12.62     1.17     23.8     .02
 389.9    4.81     11.11      .93     22.4     .28
 261.8    2.83     13.19      .94     12.3     .13
 156.4     .30     12.30     1.19     84.7     .16
2029.4    4.58      9.54      .98     57.6     .13
 TØTAL CYCLE 3     281.4 PPM  HC 1.18 CØ 13.77 CØ2
 381.5    6.16     10.98      .88     14.0     .23
 230.2     .74     12.23     1.16     65.0     .21
 169.2     .18     12.83     1.15     23.0     .02
 454.9    4.75     11.00      .94     26.4     .28
 261.8    2.47     13.34      .95     12.4     .12
 167.2     .29     12.23     1.20     91.2     .16
2093.3    4.61      9.43      .98     59.5     .13
 TØTAL CYCLE 4     291.5 PPM  HC 1.14 CØ 13.81 CØ2
 354.5    6.21     10.71      .89     13.2     .23
 229.2     .80     12.28     1.15     64.1     .23
 157.3     .17     12.75     1.16     21.6     .02
 534.3    4.59     10.89      .95     31.5     .27
 245.5    3.29     12.80      .93     11.4     .15
 170.2     .28     12.15     1.21     93.4     .15
2102.5    4.39      9.26     1.01     61.3     .13
 TØTAL CYCLE 6     296.6 PPM  HC 1.18 CØ 13.76 CØ2
 371.1    6.15     10.89      .88     13.7     .23
 245.5     .76     12.32     1.15     68.6     .21
 167.2     .18     12.75     1.16     22.9     .02
 409.7    4.68     11.02      .94     23.9     .27
 238.4    2.81     13.03      .95     11.3     .13
 170.2     .30     12.06     1.21     94.0     .16
2185.3    4.30      9.26     1.01     63.9     .13
 TØTAL CYCLE 7     298.4 PPM  HC 1.16 CØ 13.79 CØ2
AVERAGE ØF CYCLES 1-4         323.9 PPM HC    1.55    CØ   13.39    CØ2
AVERAGE ØF CYCLES 6-7         297.5 PPM HC    1.17    CØ   13.77    CØ2
WEIGHTED SUM                  306.7 PPM HC    1.30    CØ   13.64    CØ2

*STØP*
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FIGURE 4

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2-1455 02-07-69   FØRD FAIRLANE              720408        37241 MILES   3500#
EXPERIMENTAL WITH ØUT PØLLUTIØN MASTER

 SUM             CYCLES 1-4                                 CYCLES 6-7
   373.0747      1.5348   13.4063           338.2631     1.2036    13.7475
        TØTAL WEIGHTED SUM       350.4472           1.3195         13.6281

  HC       CØ      CØ2      FACTØR   WHC      WCØ
  389.9    5.16    11.44     .90     14.8     .20
  392.0    3.03    12.55     .96     92.1     .71
  326.5    3.68    12.50     .93     35.7     .40
  847.1    8.74     9.00     .82     43.2     .45
  385.7    5.29    11.60     .89     17.1     .23
  294.5     .47    13.63    1.06    142.5     .23
 3720.6    5.15     7.75     .99    107.0     .15
 TØTAL CYCLE 1    452.4 PPM  HC 2.37 CØ  12.54 CØ2
  487.6    6.01    11.07     .88     18.0     .22
  314.1     .93    12.47    1.12     85.8     .25
  209.1     .19    13.26    1.12     27.5     .02
  439.1    5.81    10.64     .90     24.4     .32
  310.0    3.21    13.11     .92     14.2     .15
  218.1     .24    12.20    1.21    119.6     .13
 2419.1    4.74     9.24     .97     68.2     .13
 TØTAL CYCLE 2    357.7 PPM  HC 1.24 CØ  13.71 CØ2
  488.7    6.08    11.04     .88     18.0     .22
  316.2     .84    12.70    1.11     85.4     .23
  202.1     .16    13.11    1.13     26.9     .02
  337.9    5.11    11.20     .91     19.0     .29
  282.2    3.38    13.06     .91     12.9     .15
  225.2     .28    12.62    1.16    119.1     .15
 1947.9    4.61     9.69     .97     54.8     .13
 TØTAL CYCLE 3    336.2 PPM  HC 1.19 CØ  13.76 CØ2
  451.7    5.88    11.18     .88     16.7     .22
  316.2     .95    12.60    1.11     85.4     .26
  202.1     .17    13.24    1.12     26.7     .02
  397.2    4.98    11.18     .91     22.5     .28
  291.4    3.05    13.16     .93     13.5     .14
  234.3     .30    12.62    1.16    123.7     .16
 1885.1    4.60     9.77     .97     52.9     .13
 TØTAL CYCLE 4    341.4 PPM  HC 1.21 CØ  13.75 CØ2
  398.2    5.72    11.09     .89     14.9     .21
  291.4    1.02    12.62    1.10     78.2     .27
  186.1     .17    13.19    1.12     24.7     .02
  469.7    4.75    11.18     .92     26.9     .27
  265.8    3.02    13.19     .93     12.3     .14
  229.2     .30    12.70    1.15    120.3     .16
 2002.2    4.37     9.65     .99     57.2     .12
 TØTAL CYCLE 6    334.6 PPM  HC 1.21 CØ  13.74 CØ2
  485.5    5.29    11.58     .89     18.1     .20
  330.6    1.02    12.83    1.08     87.4     .27
  205.1     .25    13.74    1.07     25.9     .03
  425.5    4.74    11.39     .92     24.1     .27
  265.8    2.98    13.24     .92     12.3     .14
  230.2     .33    12.83    1.14    119.5     .17
 1912.0    4.36     9.75     .98     54.5     .12
 TØTAL CYCLE 7    341.9 PPM  HC 1.20 CØ 13.75 CØ2
AVERAGE ØF CYCLES 1-4        371.9 PPM HC    1.50    CØ   13.44    CØ2
AVERAGE ØF CYCLES 6-7        338.2 PPM HC    1.20    CØ   13.75    CØ2
WEIGHTED SUM                 350.0 PPM HC    1.31    CØ   13.64    CØ2

*STØP*
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FIGURE 5

2-1458 02-08-69   FØRD FAIRLANE   720408   37283 MILES   3500#

EXPERIMENTAL WITH PØLLUTIØN MASTER

SUM	CYCLES 1-4			CYCLES 6-7	
336.9456	1.2980	13.6453	293.7985	.8306	14.1191
TØTAL WEIGHTED SUM			308.9000	.9942	13.9533

HC	CØ	CØ2	FACTØR	WHC	WCØ
347.2	4.83	10.98	.95	13.8	.19
375.3	3.39	12.18	.96	88.3	.80
333.7	4.48	11.96	.91	35.9	.48
829.2	7.49	8.57	.91	46.6	.42
359.7	5.44	11.09	.91	16.3	.25
305.8	.78	13.82	1.03	143.0	.36
2775.8	3.97	8.57	1.06	85.0	.12
TØTAL CYCLE 1	428.9 PPM HC	2.62 CØ	12.30 CØ2		
279.1	2.82	11.51	1.05	12.3	.12
236.3	.49	12.62	1.14	66.0	.14
197.0	.20	13.45	1.10	25.6	.03
256.7	3.51	11.51	.99	15.7	.21
242.4	1.89	13.11	1.00	12.1	.09
201.0	.23	12.67	1.16	106.3	.12
2213.0	2.85	9.61	1.09	69.8	.09
TØTAL CYCLE 2	307.8 PPM HC	.81 CØ	14.14 CØ2		
249.5	2.44	11.79	1.05	11.0	.11
228.2	.48	12.95	1.12	62.2	.13
185.1	.21	13.42	1.10	24.0	.03
238.4	2.63	12.01	1.02	15.0	.17
239.4	2.10	13.00	.99	11.9	.10
206.1	.24	13.13	1.12	105.1	.12
2011.3	2.32	9.83	1.12	65.5	.08
TØTAL CYCLE 3	294.8 PPM HC	.74 CØ	14.22 CØ2		
269.9	2.55	11.69	1.05	11.9	.11
254.6	.68	13.13	1.09	67.5	.18
193.0	.17	13.63	1.09	24.7	.02
227.2	2.72	11.96	1.01	14.3	.17
244.4	2.20	12.80	1.00	12.2	.11
223.2	.32	13.26	1.10	112.1	.16
1929.9	2.30	9.92	1.12	62.7	.07
TØTAL CYCLE 4	305.5 PPM HC	.83 CØ	14.12 CØ2		
236.3	2.68	11.39	1.07	10.6	.12
232.3	.73	13.13	1.08	61.3	.19
178.1	.23	13.69	1.08	22.6	.03
306.9	2.47	11.91	1.03	19.6	.16
208.1	2.27	12.65	1.01	10.5	.11
204.1	.31	13.32	1.10	102.2	.15
1947.9	2.16	9.81	1.14	64.5	.07
TØTAL CYCLE 6	291.3 PPM HC	.84 CØ	14.11 CØ2		
246.5	2.59	11.62	1.06	10.9	.11
237.3	.70	13.16	1.08	62.7	.18
195.0	.29	13.90	1.06	24.3	.04
262.8	2.55	11.98	1.02	16.6	.16
221.2	1.96	12.93	1.01	11.1	.10
205.1	.31	13.21	1.11	103.5	.16
2002.2	2.02	9.75	1.16	67.1	.07
TØTAL CYCLE 7	296.3 PPM HC	.82 CØ	14.13 CØ2		

AVERAGE ØF CYCLES 1-4	334.3 PPM HC	1.25	CØ	13.69	CØ2
AVERAGE ØF CYCLES 6-7	293.8 PPM HC	.83	CØ	14.12	CØ2
WEIGHTED SUM	308.0 PPM HC	.98	CØ	13.97	CØ2

STØP

FIGURE 6

2-1464 02-11-69 FØRD FAIRLANE 720408 37532 MILES 3500#
EXPERIMENTAL WITH PØLLUTIØN MASTER

SUM	CYCLES 1-4			CYCLES 6-7	
294.1678	1.1601	13.7920	280.7896	.5706	14.3755
TØTAL WEIGHTED SUM			285.4720	.7769	14.1712

HC	CØ	CØ2	FACTØR	WHC	WCØ
293.5	3.10	12.25	.98	12.0	.13
328.6	2.83	12.37	.99	79.1	.68
295.6	4.37	11.98	.92	32.0	.47
277.1	6.66	10.19	.88	15.1	.36
321.3	4.80	11.60	.91	14.7	.22
282.2	1.12	13.66	1.02	130.3	.52
1690.2	4.46	9.98	.97	47.6	.13
TØTAL CYCLE 1		330.9 PPM	HC 2.51 CØ	12.46 CØ2	
215.1	2.51	12.40	1.01	9.1	.11
208.1	.56	13.13	1.10	55.6	.15
172.1	.19	13.50	1.10	22.3	.02
233.3	2.72	11.98	1.01	14.6	.17
189.0	1.22	13.42	1.02	9.7	.06
171.2	.20	12.60	1.17	91.3	.11
2020.3	2.39	9.96	1.11	64.8	.08
TØTAL CYCLE 2		267.3 PPM	HC .70 CØ	14.26 CØ2	
293.5	2.27	12.10	1.04	12.9	.10
220.1	.45	12.70	1.14	61.3	.13
151.4	.13	12.65	1.17	21.0	.02
398.2	1.97	11.93	1.06	26.2	.13
184.1	1.21	13.42	1.03	9.4	.06
181.1	.19	12.78	1.16	95.3	.10
1920.9	2.15	9.83	1.14	63.6	.07
TØTAL CYCLE 3		289.6 PPM	HC .61 CØ	14.34 CØ2	
251.6	2.17	12.23	1.04	11.0	.09
208.1	.48	12.88	1.12	57.0	.13
151.4	.17	12.72	1.16	20.8	.02
465.4	1.97	11.79	1.07	30.8	.13
185.1	1.08	13.37	1.04	9.6	.06
180.1	.18	12.78	1.16	94.8	.10
1804.8	1.97	10.04	1.15	59.9	.07
TØTAL CYCLE 4		284.1 PPM	HC .60 CØ	14.35 CØ2	
224.2	1.91	12.06	1.07	10.1	.09
199.0	.44	12.78	1.13	55.1	.12
143.6	.13	12.83	1.16	19.6	.02
520.5	1.76	11.69	1.09	35.2	.12
172.1	.92	13.45	1.04	9.0	.05
178.1	.17	12.78	1.16	93.9	.09
1912.0	1.84	9.96	1.16	64.3	.06
TØTAL CYCLE 6		287.2 PPM	HC .54 CØ	14.40 CØ2	
237.3	1.93	12.25	1.06	10.5	.09
216.1	.44	13.13	1.10	58.3	.12
156.4	.16	13.06	1.14	20.9	.02
375.3	1.84	12.08	1.06	24.7	.12
167.2	1.37	13.00	1.04	8.7	.07
183.1	.22	12.88	1.15	95.4	.11
1699.0	1.94	10.23	1.14	56.0	.06
TØTAL CYCLE 7		274.6 PPM	HC .60 CØ	14.35 CØ2	

AVERAGE ØF CYCLES 1-4	293.0 PPM HC	1.10	CØ	13.85	CØ2
AVERAGE ØF CYCLES 6-7	280.9 PPM HC	.57	CØ	14.38	CØ2
WEIGHTED SUM	285.1 PPM HC	.76	CØ	14.19	CØ2

STØP

FIGURE 7

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8-1475 02-14-69   FORD FAIRLANE            720408       37633 MILES  3500#
EXPERIMENTAL ( WITH OUT DEVICE )

 SUM             CYCLES 1-4                                  CYCLES 6-7
   327.2657     1.2129   13.7404          352.3084     .6303    14.3135
         TOTAL WEIGHTED SUM     343.3685          .8342        14.1161

   HC       CO       CO2     FACTOR    WHC      WCO
  241.0    2.98    12.98      .94     13.5      .12
  369.0    2.81    12.75      .96     86.8      .66
  301.7    4.13    12.42      .91     32.3      .44
  221.3    7.32    10.40      .84     16.7      .33
  353.4    5.32    11.77      .88     15.5      .23
  299.7     .78    13.98     1.02    138.5      .36
 2428.5    4.42     9.73      .96     67.7      .12
 TOTAL CYCLE 1    370.9 PPM   HC 2.32 CO 12.63 CO2
  335.8    3.58    12.88      .91     12.9      .14
  277.1     .95    12.80     1.09     73.8      .25
  193.0     .17    13.88     1.07     24.3      .02
  232.3    3.47    12.75      .92     13.2      .20
  232.3    1.73    13.93      .96     11.1      .08
  200.0     .21    12.30     1.20    109.2      .11
 2203.7    3.03    10.36     1.02     65.1      .09
 TOTAL CYCLE 2    309.6 PPM   HC   .90 CO 14.06 CO2
  399.3    3.29    13.08      .92     15.4      .13
  287.3     .62    12.75     1.12     78.6      .17
  178.1     .15    13.00     1.14     24.0      .02
  283.2    2.63    12.93      .95     16.7      .16
  236.3    1.37    14.15      .97     11.4      .07
  209.1     .22    12.60     1.17    111.3      .12
 1934.1    2.58    10.73     1.03     59.5      .08
 TOTAL CYCLE 3    317.0 PPM   HC   .73 CO 14.22 CO2
  373.2    2.94    13.21      .93     14.6      .11
  280.2     .69    12.85     1.11     75.7      .19
  181.1     .15    13.24     1.12     23.9      .02
  313.1    2.46    13.08      .95     18.5      .15
  222.2    1.43    14.29      .95     10.6      .07
  204.1     .22    12.60     1.17    103.7      .12
 1769.3    2.41    11.02     1.04     53.1      .07
 TOTAL CYCLE 4    305.1 PPM   HC   .72 CO 14.23 CO2
  299.7    2.37    13.16      .97     12.2      .10
  236.3     .47    12.60     1.15     66.2      .13
  163.2     .13    12.75     1.16     22.4      .02
  349.3    2.14    12.70     1.00     21.6      .13
  208.1    1.36    13.85      .99     10.3      .07
  198.0     .19    12.30     1.20    108.2      .10
 2056.8    2.22    10.27     1.09     65.2      .07
 TOTAL CYCLE 6    306.0 PPM   HC   .62 CO 14.33 CO2
  348.8    2.05    12.62     1.02     36.4      .09
  436.0     .53    12.40     1.16    123.4      .15
  194.0     .16    12.85     1.15     26.4      .02
  420.2    2.02    12.75     1.00     26.0      .12
  232.3    1.27    13.90      .99     11.5      .06
  219.1     .22    12.35     1.19    119.0      .12
 1849.2    2.27    10.51     1.08     57.9      .07
 TOTAL CYCLE 7    400.6 PPM   HC   .64 CO 14.31 CO2
AVERAGE OF CYCLES 1-4        325.6 PPM HC    1.17   CO   13.79   CO2
AVERAGE OF CYCLES 6-7        353.3 PPM HC     .63   CO   14.32   CO2
WEIGHTED SUM                 343.6 PPM HC     .82   CO   14.13   CO2

*STOP*
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FIGURE 1A

2-1447 02-04-69 FØRD FAIRLANE 720408 37060 MILES 3500#

EXPERIMENTAL w/o Device

HC	CØ	CØ2	FACTØR	WHC	WCØ
473.9	9.87	8.47	1.04	20.7	.43
423.4	4.31	11.67	1.02	104.9	1.07
325.5	3.98	12.20	1.00	38.3	.47
694.1	9.35	8.79	1.02	43.9	.59
394.1	5.29	11.60	.99	19.5	.26
305.8	.80	13.69	1.01	139.9	.37
3288.7	6.15	7.81	1.00	95.8	.18
TØTAL CYCLE 1	463.0 PPM HC	3.37 CØ	12.32 CØ2		
417.1	5.84	11.23	.99	17.4	.24
283.2	.99	11.91	1.14	78.8	.28
187.1	.16	12.37	1.15	25.3	.02
443.3	5.95	10.27	1.06	29.0	.39
304.8	2.64	13.32	.97	14.8	.13
193.0	.31	11.93	1.18	103.6	.17
2629.3	4.97	8.94	1.02	77.5	.15
TØTAL CYCLE 2	346.4 PPM HC	1.37 CØ	13.44 CØ2		
442.3	6.56	10.77	1.00	18.5	.27
290.4	.98	12.42	1.10	77.7	.26
193.0	.18	12.67	1.12	25.5	.02
354.5	5.00	11.07	1.04	22.8	.32
291.4	2.65	13.40	.96	14.1	.13
170.2	.33	12.37	1.14	88.2	.17
2259.5	4.70	9.28	1.03	67.5	.14
TØTAL CYCLE 3	314.3 PPM HC	1.32 CØ	13.50 CØ2		
424.4	6.51	10.86	.99	17.7	.27
274.0	.94	12.50	1.09	73.1	.25
184.1	.19	12.65	1.12	24.3	.03
461.2	4.82	11.00	1.04	29.8	.31
287.3	2.31	13.47	.97	13.9	.11
188.1	.32	12.37	1.14	97.4	.17
2203.7	4.70	9.41	1.03	65.5	.14
TØTAL CYCLE 4	321.8 PPM HC	1.28 CØ	13.51 CØ2		
381.5	6.30	10.82	1.01	16.2	.27
280.2	1.16	12.65	1.07	73.2	.30
176.1	.25	13.19	1.07	22.3	.03
506.7	4.91	10.86	1.05	32.8	.32
275.0	2.46	13.32	.98	13.4	.12
205.1	.31	12.55	1.12	104.7	.16
2093.3	4.63	9.17	1.05	64.0	.14
TØTAL CYCLE 6	326.7 PPM HC	1.34 CØ	13.48 CØ2		
397.2	6.06	11.00	1.00	16.7	.26
285.3	.99	12.72	1.07	74.6	.26
199.0	.23	13.42	1.05	24.8	.03
518.4	4.88	11.02	1.03	33.2	.31
277.1	3.09	13.08	.97	13.5	.15
208.1	.39	12.47	1.12	106.5	.20
2231.6	4.62	9.13	1.05	67.8	.14
TØTAL CYCLE 7	337.0 PPM HC	1.34 CØ	13.46 CØ2		

AVERAGE ØF CYCLES 1-4	361.4 PPM HC	1.84 CØ	13.19 CØ2
AVERAGE ØF CYCLES 6-7	331.9 PPM HC	1.34 CØ	13.47 CØ2
WEIGHTED SUM	342.2 PPM HC	1.52 CØ	13.37 CØ2

AUTØMATIC MASS EMISSIØNS

HC 3.96 GRAMS PER MILE CØ 32.9 GRAMS PER MILE

STØP

FIGURE 3A

2-1451 02-06-69 FØRD FAIRLANE 720408 37195 MILES 3500#
EXPERIMENTAL *w/o Device*

HC	CØ	CØ2	FACTØR	WHC	WCØ
30.7	.63	1.56	7.59	9.8	.20
372.2	3.37	12.28	1.01	91.7	.83
306.9	3.81	12.30	1.00	36.1	.45
910.1	9.03	8.61	1.03	58.0	.58
279.1	5.83	11.11	1.01	14.1	.29
258.7	.78	13.53	1.02	120.2	.36
3569.1	5.33	7.88	1.01	104.2	.16

TØTAL CYCLE 1 434.2 PPM HC 2.87 CØ 12.60 CØ2

HC	CØ	CØ2	FACTØR	WHC	WCØ
416.0	6.51	10.69	1.01	17.6	.28
277.1	.95	11.91	1.14	77.3	.27
229.2	.16	12.50	1.13	30.6	.02
403.5	5.67	10.55	1.05	26.2	.37
275.0	2.48	13.32	.98	13.4	.12
166.2	.27	11.89	1.19	89.9	.14
1957.0	4.79	9.69	1.02	58.0	.14

TØTAL CYCLE 2 313.0 PPM HC 1.34 CØ 13.49 CØ2

HC	CØ	CØ2	FACTØR	WHC	WCØ
367.0	6.05	11.04	1.00	15.4	.25
241.4	.84	12.32	1.11	65.7	.23
172.1	.18	12.62	1.12	22.8	.02
389.9	4.81	11.11	1.04	25.1	.31
261.8	2.83	13.19	.97	12.7	.14
156.4	.30	12.30	1.15	81.8	.16
2029.4	4.58	9.54	1.03	60.9	.14

TØTAL CYCLE 3 284.4 PPM HC 1.25 CØ 13.57 CØ2

HC	CØ	CØ2	FACTØR	WHC	WCØ
381.5	6.16	10.98	1.00	16.1	.26
230.2	.74	12.23	1.13	63.4	.20
169.2	.18	12.83	1.11	22.1	.02
454.9	4.75	11.00	1.05	29.5	.31
261.8	2.47	13.34	.98	12.8	.12
167.2	.29	12.23	1.16	87.9	.15
2093.3	4.61	9.43	1.04	62.9	.14

TØTAL CYCLE 4 294.6 PPM HC 1.21 CØ 13.58 CØ2

HC	CØ	CØ2	FACTØR	WHC	WCØ
354.5	6.21	10.71	1.02	15.2	.27
229.2	.80	12.28	1.12	62.7	.22
157.3	.17	12.75	1.12	20.7	.02
534.3	4.59	10.89	1.05	34.9	.30
245.5	3.29	12.80	.99	12.1	.16
170.2	.28	12.15	1.16	90.0	.15
2102.5	4.39	9.26	1.06	64.4	.13

TØTAL CYCLE 6 300.1 PPM HC 1.25 CØ 13.55 CØ2

HC	CØ	CØ2	FACTØR	WHC	WCØ
371.1	6.15	10.89	1.01	15.7	.26
245.5	.76	12.32	1.12	66.9	.21
167.2	.18	12.75	1.11	22.0	.02
409.7	4.68	11.02	1.05	26.7	.30
238.4	2.81	13.03	.99	11.8	.14
170.2	.30	12.06	1.17	90.6	.16
2185.3	4.30	9.26	1.05	66.7	.13

TØTAL CYCLE 7 300.5 PPM HC 1.23 CØ 13.56 CØ2

AVERAGE ØF CYCLES 1-4	331.6 PPM HC	1.66	CØ	13.31	CØ2
AVERAGE ØF CYCLES 6-7	300.3 PPM HC	1.24	CØ	13.56	CØ2
WEIGHTED SUM	311.2 PPM HC	1.39	CØ	13.47	CØ2

AUTØMATIC MASS EMISSIØNS
HC 3.60 GRAMS PER MILE CØ 30.2 GRAMS PER MILE

STØP

FIGURE 2A

2-1448 02-05-69 FØRD FAIRLANE 720408 37083 MILES 3500#
EXPERIMENTAL w Device

HC	CØ	CØ2	FACTØR	WHC	WCØ
204.1	.93	13.21	1.04	8.9	.04
278.1	1.75	13.06	1.02	69.1	.43
276.1	2.39	13.34	.98	31.8	.28
277.1	4.69	11.27	1.04	17.9	.30
262.8	1.80	13.21	1.01	13.2	.09
222.2	.34	13.55	1.04	105.0	.16
2619.7	2.02	9.17	1.11	84.6	.07
TØTAL CYCLE 1		330.7 PPM HC	1.37 CØ	13.46 CØ2	
218.1	.48	12.13	1.15	10.5	.02
186.1	.29	12.15	1.16	52.7	.08
149.5	.15	12.03	1.18	20.8	.02
822.7	.82	10.82	1.20	61.0	.06
247.5	.26	13.13	1.07	13.3	.01
154.4	.19	12.30	1.15	81.1	.10
2381.3	1.05	9.19	1.18	81.5	.04
TØTAL CYCLE 2		320.9 PPM HC	.34 CØ	13.99 CØ2	
279.1	.29	11.93	1.17	13.7	.01
206.1	.28	12.55	1.12	56.5	.08
149.5	.18	12.06	1.18	20.8	.03
1246.3	.50	10.29	1.22	94.2	.04
181.1	.34	13.00	1.08	9.8	.02
144.6	.21	12.55	1.13	74.5	.11
2362.5	.77	8.66	1.25	85.7	.03
TØTAL CYCLE 3		355.2 PPM HC	.31 CØ	13.96 CØ2	
367.0	.29	11.60	1.19	18.4	.01
227.2	.27	12.57	1.12	62.1	.07
156.4	.18	12.15	1.17	21.6	.02
1271.3	.44	10.32	1.22	96.0	.03
198.0	.28	13.00	1.09	10.7	.01
164.2	.20	12.30	1.15	86.2	.10
2268.8	.76	8.72	1.26	82.6	.03
TØTAL CYCLE 4		377.5 PPM HC	.29 CØ	13.95 CØ2	
346.2	.18	11.60	1.20	17.5	.01
214.1	.25	12.50	1.13	58.9	.07
141.6	.16	12.20	1.17	19.5	.02
1163.6	.42	10.25	1.24	89.3	.03
243.6	.27	12.78	1.10	13.4	.01
135.8	.17	12.30	1.16	71.5	.09
2185.3	.68	8.76	1.26	80.2	.02
TØTAL CYCLE 6		350.2 PPM HC	.26 CØ	13.99 CØ2	
295.6	.23	11.84	1.18	14.7	.01
217.1	.23	12.47	1.13	59.9	.06
157.3	.17	12.30	1.15	21.4	.02
1221.5	.41	10.25	1.23	93.2	.03
186.1	.24	12.95	1.09	10.2	.01
158.3	.18	12.30	1.15	83.2	.09
2176.1	.67	8.61	1.28	81.0	.02
TØTAL CYCLE 7		363.5 PPM HC	.26 CØ	13.98 CØ2	

AVERAGE ØF CYCLES 1-4	346.1 PPM HC	.58	CØ	13.84	CØ2
AVERAGE ØF CYCLES 6-7	356.9 PPM HC	.26	CØ	13.98	CØ2
WEIGHTED SUM	353.1 PPM HC	.37	CØ	13.93	CØ2

AUTØMATIC MASS EMISSIØNS
HC 4.09 GRAMS PER MILE CØ 8.1 GRAMS PER MILE

STØP

FIGURE 5A

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2-1458 02-08-69   FØRD FAIRLANE            720408        37283 MILES   3500#
EXPERIMENTAL WITH PØLLUTIØN MASTER

   HC      CØ      CØ2     FACTØR   WHC      WCØ
  347.2   4.83   10.98    1.05     15.4     .21
  375.3   3.39   12.18    1.02     93.0     .84
  333.7   4.48   11.96    1.00     39.2     .53
  829.2   7.49    8.57    1.10     56.4     .51
  359.7   5.44   11.09    1.02     18.4     .28
  305.8    .78   13.82    1.00    138.8     .35
 2775.8   3.97    8.57    1.07     86.1     .12
 TØTAL CYCLE 1   447.3 PPM  HC 2.84 CØ  12.60 CØ2
  279.1   2.82   11.51    1.10     12.9     .13
  236.3    .49   12.62    1.10     63.7     .13
  197.0    .20   13.45    1.05     24.5     .02
  256.7   3.51   11.51    1.07     17.0     .23
  242.4   1.89   13.11    1.01     12.3     .10
  201.0    .23   12.67    1.11    102.0     .12
 2213.0   2.85    9.61    1.08     69.3     .09
 TØTAL CYCLE 2   301.7 PPM  HC   .82 CØ  13.76 CØ2
  249.5   2.44   11.79    1.09     11.4     .11
  228.2    .48   12.95    1.08     60.1     .13
  185.1    .21   13.42    1.06     23.1     .03
  238.4   2.63   12.01    1.07     15.8     .17
  239.4   2.10   13.00    1.01     12.1     .11
  206.1    .24   13.13    1.08    100.9     .12
 2011.3   2.32    9.83    1.10     64.2     .07
 TØTAL CYCLE 3   287.6 PPM  HC   .74 CØ  13.82 CØ2
  269.9   2.55   11.69    1.09     12.4     .12
  254.6    .68   13.13    1.05     65.5     .17
  193.0    .17   13.63    1.04     23.7     .02
  227.2   2.72   11.96    1.07     15.1     .18
  244.4   2.20   12.80    1.02     12.5     .11
  223.2    .32   13.26    1.06    107.8     .15
 1929.9   2.30    9.92    1.10     61.7     .07
 TØTAL CYCLE 4   298.7 PPM  HC   .83 CØ  13.76 CØ2
  236.3   2.68   11.39    1.12     11.1     .13
  232.3    .73   13.13    1.05     59.8     .19
  178.1    .23   13.69    1.04     21.8     .03
  306.9   2.47   11.91    1.08     20.5     .16
  208.1   2.27   12.65    1.04     10.8     .12
  204.1    .31   13.32    1.06     98.3     .15
 1947.9   2.16    9.81    1.12     63.0     .07
 TØTAL CYCLE 6   285.2 PPM  HC   .84 CØ  13.77 CØ2
  246.5   2.59   11.62    1.10     11.4     .12
  237.3    .70   13.16    1.05     61.0     .18
  195.0    .29   13.90    1.02     23.4     .03
  262.8   2.55   11.98    1.07     17.4     .17
  221.2   1.96   12.93    1.03     11.3     .10
  205.1    .31   13.21    1.07     99.5     .15
 2002.2   2.02    9.75    1.12     65.1     .07
 TØTAL CYCLE 7   289.3 PPM   HC   .82 CØ  13.78 CØ2
AVERAGE ØF CYCLES 1-4        333.8 PPM HC   1.31    CØ   13.49    CØ2
AVERAGE ØF CYCLES 6-7        287.2 PPM HC    .83    CØ   13.77    CØ2
WEIGHTED SUM                 303.5 PPM HC   1.00    CØ   13.67    CØ2


  AUTØMATIC     MASS EMISSIØNS
HC     3.51 GRAMS PER MILE      CØ  21.7 GRAMS PER MILE

*STØP*
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FIGURE 4A

2-1455 02-07-69 FØRD FAIRLANE 720408 37241 MILES 35.
EXPERIMENTAL w/o Device

HC	CØ	CØ2	FACTØR	WHC	WCØ	
389.9	5.16	11.44	1.00	16.4	.22	
392.0	3.03	12.55	1.00	95.7	.74	
326.5	3.68	12.50	.99	38.0	.43	
847.1	8.74	9.00	1.02	53.3	.55	
385.7	5.29	11.60	.99	19.1	.26	
294.5	.47	13.63	1.02	137.0	.22	
3720.6	5.15	7.75	1.01	109.1	.15	
TØTAL CYCLE 1		468.6 PPM	HC 2.57	CØ	12.71	CØ2
487.6	6.01	11.07	.99	20.3	.25	
314.1	.93	12.47	1.09	83.7	.25	
209.1	.19	13.26	1.07	26.3	.02	
439.1	5.81	10.64	1.03	28.2	.37	
310.0	3.21	13.11	.96	14.9	.15	
218.1	.24	12.20	1.15	114.6	.13	
2419.1	4.74	9.24	1.02	71.5	.14	
TØTAL CYCLE 2		359.6 PPM	HC 1.32	CØ	13.45	CØ2
488.7	6.08	11.04	.99	20.4	.25	
316.2	.84	12.70	1.08	83.1	.22	
202.1	.16	13.11	1.08	25.8	.02	
337.9	5.11	11.20	1.03	21.5	.33	
282.2	3.38	13.06	.96	13.6	.16	
225.2	.28	12.62	1.11	114.2	.14	
1947.9	4.61	9.69	1.03	58.1	.14	
TØTAL CYCLE 3		336.7 PPM	HC 1.26	CØ	13.50	CØ2
451.7	5.88	11.18	.99	18.8	.25	
316.2	.95	12.60	1.08	83.4	.25	
202.1	.17	13.24	1.07	25.5	.02	
397.2	4.98	11.18	1.03	25.3	.32	
291.4	3.05	13.16	.97	14.1	.15	
234.3	.30	12.62	1.11	118.7	.15	
1885.1	4.60	9.77	1.03	56.2	.14	
TØTAL CYCLE 4		342.0 PPM	HC 1.27	CØ	13.49	CØ2
398.2	5.72	11.09	1.01	16.9	.24	
291.4	1.02	12.62	1.08	76.7	.27	
186.1	.17	13.19	1.08	23.6	.02	
469.7	4.75	11.18	1.03	30.0	.30	
265.8	3.02	13.19	.97	12.9	.15	
229.2	.30	12.70	1.11	115.5	.15	
2002.2	4.37	9.65	1.04	60.1	.13	
TØTAL CYCLE 6		335.7 PPM	HC 1.27	CØ	13.50	CØ2
485.5	5.29	11.58	.98	20.1	.22	
330.6	1.02	12.83	1.06	85.4	.26	
205.1	.25	13.74	1.03	24.9	.03	
425.5	4.74	11.39	1.02	26.9	.30	
265.8	2.98	13.24	.97	12.8	.14	
230.2	.33	12.83	1.10	114.7	.16	
1912.0	4.36	9.75	1.04	57.4	.13	
TØTAL CYCLE 7		342.3 PPM	HC 1.25	CØ	13.50	CØ2

AVERAGE ØF CYCLES 1-4	376.7 PPM HC	1.61	CØ	13.29	CØ2
AVERAGE ØF CYCLES 6-7	339.0 PPM HC	1.26	CØ	13.50	CØ2
WEIGHTED SUM	352.2 PPM HC	1.38	CØ	13.43	CØ2

AUTØMATIC MASS EMISSIØNS
HC 4.08 GRAMS PER MILE CØ 30.0 GRAMS PER MILE

STØP

FIGURE 6 A

2-1464 02-11-69 FØRD FAIRLANC 720408 37532 MILES 3500#
EXPERIMENTAL *w Device*

HC	CØ	CØ2	FACTØR	WHC	WCØ
293.5	3.10	12.25	1.03	12.7	.13
328.6	2.83	12.37	1.03	82.2	.71
295.6	4.37	11.98	1.00	34.9	.52
277.1	6.66	10.19	1.05	18.0	.43
321.3	4.80	11.60	1.01	16.2	.24
282.2	1.12	13.66	1.00	128.2	.51
1690.2	4.46	9.98	1.03	50.6	.13

TØTAL CYCLE 1 342.8 PPM HC 2.68 CØ 12.79 CØ2

215.1	2.51	12.40	1.04	9.4	.11
208.1	.56	13.13	1.06	54.0	.15
172.1	.19	13.50	1.05	21.4	.02
233.3	2.72	11.98	1.07	15.4	.18
189.0	1.22	13.42	1.02	9.6	.06
171.2	.20	12.60	1.13	87.7	.10
2020.3	2.39	9.96	1.09	63.7	.08

TØTAL CYCLE 2 261.2 PPM HC .70 CØ 13.87 CØ2

293.5	2.27	12.10	1.07	13.2	.10
220.1	.45	12.70	1.10	59.2	.12
151.4	.13	12.65	1.13	20.1	.02
398.2	1.97	11.93	1.09	26.8	.13
184.1	1.21	13.42	1.02	9.4	.06
181.1	.19	12.78	1.11	91.4	.10
1920.9	2.15	9.83	1.12	62.2	.07

TØTAL CYCLE 3 282.3 PPM HC .60 CØ 13.89 CØ2

251.6	2.17	12.23	1.07	11.3	.10
208.1	.48	12.88	1.09	55.2	.13
151.4	.17	12.72	1.12	20.0	.02
465.4	1.97	11.79	1.09	31.5	.13
185.1	1.08	13.37	1.03	9.5	.06
180.1	.18	12.78	1.11	91.0	.09
1804.8	1.97	10.04	1.12	58.5	.06

TØTAL CYCLE 4 276.9 PPM HC .59 CØ 13.90 CØ2

224.2	1.91	12.06	1.09	10.3	.09
199.0	.44	12.78	1.10	53.3	.12
143.6	.13	12.83	1.11	18.8	.02
520.5	1.76	11.69	1.10	35.6	.12
172.1	.92	13.45	1.03	8.9	.05
178.1	.17	12.78	1.11	90.0	.09
1912.0	1.84	9.96	1.12	62.1	.06

TØTAL CYCLE 6 279.1 PPM HC .54 CØ 13.93 CØ2

237.3	1.93	12.25	1.08	10.7	.09
216.1	.44	13.13	1.07	56.3	.12
156.4	.16	13.06	1.09	20.1	.02
375.3	1.84	12.08	1.08	25.2	.12
167.2	1.37	13.00	1.05	8.7	.07
183.1	.22	12.88	1.10	91.6	.11
1699.0	1.94	10.23	1.11	54.8	.06

TØTAL CYCLE 7 267.4 PPM HC .59 CØ 13.92 CØ2

AVERAGE ØF CYCLES 1-4	290.8 PPM HC	1.14	CØ	13.61	CØ2
AVERAGE ØF CYCLES 6-7	273.2 PPM HC	.56	CØ	13.92	CØ2
WEIGHTED SUM	279.4 PPM HC	.77	CØ	13.82	CØ2

AUTØMATIC MASS EMISSIØNS
HC 3.23 GRAMS PER MILE CØ 16.6 GRAMS PER MILE

STØP

FIGURE 7A

2-1475 02-14-69 FØRD FAIRLANE 720408 37638 MILES 3500#
EXPERIMENTAL W/Ø DEVICE

H E W OFFICIAL VALUES

HC	CØ	CØ2	FACTØR	WHC	WCØ
341.0	2.98	12.98	.98	14.0	.12
369.0	2.81	12.75	1.00	89.7	.68
301.7	4.13	12.42	.98	34.8	.48
321.3	7.32	10.40	1.01	20.0	.46
353.4	5.32	11.77	.98	17.3	.26
299.7	.78	13.98	.99	134.5	.35
2428.5	4.42	9.73	1.00	70.1	.13
TØTAL CYCLE 1		380.5 PPM HC	2.48 CØ	12.85 CØ2	
335.8	3.58	12.88	.96	13.6	.15
277.1	.95	12.80	1.07	72.2	.25
193.0	.17	13.88	1.02	23.3	.02
232.3	3.47	12.75	.98	14.2	.21
232.3	1.73	13.93	.96	11.2	.08
200.0	.21	12.30	1.15	104.6	.11
2203.7	3.03	10.36	1.02	65.0	.09
TØTAL CYCLE 2		304.1 PPM HC	.91 CØ	13.72 CØ2	
399.3	3.29	13.08	.96	16.0	.13
287.3	.62	12.75	1.08	76.0	.17
178.1	.15	13.00	1.09	23.0	.02
283.2	2.63	12.93	1.00	17.5	.16
236.3	1.37	14.15	.96	11.4	.07
209.1	.22	12.60	1.12	106.7	.11
1984.1	2.58	10.73	1.02	58.9	.08
TØTAL CYCLE 3		309.4 PPM HC	.73 CØ	13.80 CØ2	
373.2	2.94	13.21	.96	15.1	.12
280.2	.69	12.85	1.07	73.4	.18
181.1	.15	13.24	1.07	22.9	.02
313.1	2.46	13.08	.99	19.2	.15
222.2	1.43	14.29	.95	10.6	.07
204.1	.22	12.60	1.12	104.1	.11
1769.3	2.41	11.02	1.03	52.6	.07
TØTAL CYCLE 4		298.0 PPM HC	.72 CØ	13.82 CØ2	
299.7	2.37	13.16	.99	12.4	.10
236.3	.47	12.60	1.11	63.9	.13
163.2	.13	12.75	1.12	21.5	.02
349.3	2.14	12.70	1.02	22.2	.14
208.1	1.36	13.85	.98	10.2	.07
198.0	.19	12.30	1.15	103.6	.10
2056.8	2.22	10.27	1.07	63.6	.07
TØTAL CYCLE 6		297.4 PPM HC	.61 CØ	13.87 CØ2	
848.8	2.05	12.62	1.00	35.5	.09
436.0	.53	12.40	1.10	117.4	.14
194.0	.16	12.85	1.10	25.3	.02
420.2	2.02	12.75	1.02	26.6	.13
232.3	1.27	13.90	.98	11.4	.06
219.1	.22	12.35	1.14	113.9	.12
1849.2	2.27	10.51	1.06	57.0	.07
TØTAL CYCLE 7		387.0 PPM HC	.63 CØ	13.77 CØ2	

AVERAGE ØF CYCLES 1-4	323.0 PPM HC	1.21 CØ	13.55 CØ2
AVERAGE ØF CYCLES 6-7	342.2 PPM HC	.62 CØ	13.82 CØ2
WEIGHTED SUM	335.5 PPM HC	.83 CØ	13.72 CØ2

AUTØMATIC MASS EMISSIØNS
HC 3.88 GRAMS PER MILE CØ 18.0 GRAMS PER MILE

STØP

UNITED STATES GOVERNMENT

Memorandum

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

TO : M. Korth
Through: D. Hollabaugh

DATE: May 8, 1968
PTW:vm

FROM : P. T. Willhite

SUBJECT : Kentucky Vehicle-Air Pollution Test.

A test vehicle was delivered by Mr. David A. Gravely of the Kentucky Air Pollution Control Commission on April 25, 1968, for testing by the USPHS laboratories.

Test Vehicle information:

Year and Make: 1966 Ford
Displacement: 390 cubic inches
Transmission: Automatic
License: Kentucky K16-661
Odometer Mileage: 53,564 miles

Test Procedure

The test procedure followed was the standard 7-mode exhaust emission procedure with two exceptions;

1. Since the vehicle was hot when delivered, no cold starts were obtained.

2. Mass emissions were obtained concurrently with Scott Cart emissions.

To properly precondition the test vehicle several cycles were run utilizing Indolene test fuel. After the vehicle had equilibrated, emission measurements were obtained. The vehicle was baselined with the device at the start and end of the test series. When the device was removed the PCV valve was replaced and the exhaust manifold inlets were plugged.

Test Results

Table 1 indicates the level of emissions of the test vehicle with and without the device. From this table it is evident that there is an enleanment occurring when using the device. This enleanment does not bring the car within the present level set for emissions but it does reduce the quantities of hydrocarbon and CO in the exhaust. However, this reduction in emissions is minor in respect to the initial high level of emissions.

Device in Question

Figures 1 and 2 represent the device in question as interpreted by the writer from discussions with Mr. Gravely. No physical examination of the device was made due to the short testing schedule. The device is believed to have come from the Automotive Pollution Control Corporation.

Figure 1 represents the attachment made to each exhaust manifold. Figure 2 represents the device inserted in the line from the crankcase to the intake manifold instead of the PCV valve.

As related to the writer the device functions as follows:

1. Refer to Figure 1 - during various modes of the cycle air is drawn into the exhaust manifold for further combustion (after burning).

2. Refer to Figure 2 - during all modes of the cycle this device is open for the passage of crankcase vapors to the intake manifold. These vapors pass through the venturies and impact on the offset venturies which causes a further atomization of the vapors for better combustion.

   Writers note - Since this passage is open to the atmosphere (through the breather cap) during all modes of the cycle, part or all of the enleanment may be accounted for through the addition of air to the intake manifold from this line.

Summary

The use of the device on the test vehicle did reduce emissions. However, this reduction was so minor that the device could hardly be deemed successful as an air pollution control device for this vehicle.

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Table 1

Exhaust Emissions

HC (NDIR C_6) ppmC_6	HC (NDIR C_6) gm/mile	CO %	CO gm/mile	CO_2 %	CO_2 gm/mile	NO_x gm/mile	Air/Fuel Ratio
Average Values							
Without Device (6 Cycles)							
438	4.43	2.94	64.64	12.02	475.83	3.07	13.16
With Device (12 cycles)							
411	4.02	2.32	51.93	12.65	509.99	3.32	13.78
Difference							
-27*	-0.41*	-0.62*	-12.71*	+0.63*	+34.16*	+0.25	+0.62*
% Difference							
6.2	9.3	21.1	19.7	5.0	6.7	7.6	4.5

*Statistically significant at the 95% level.

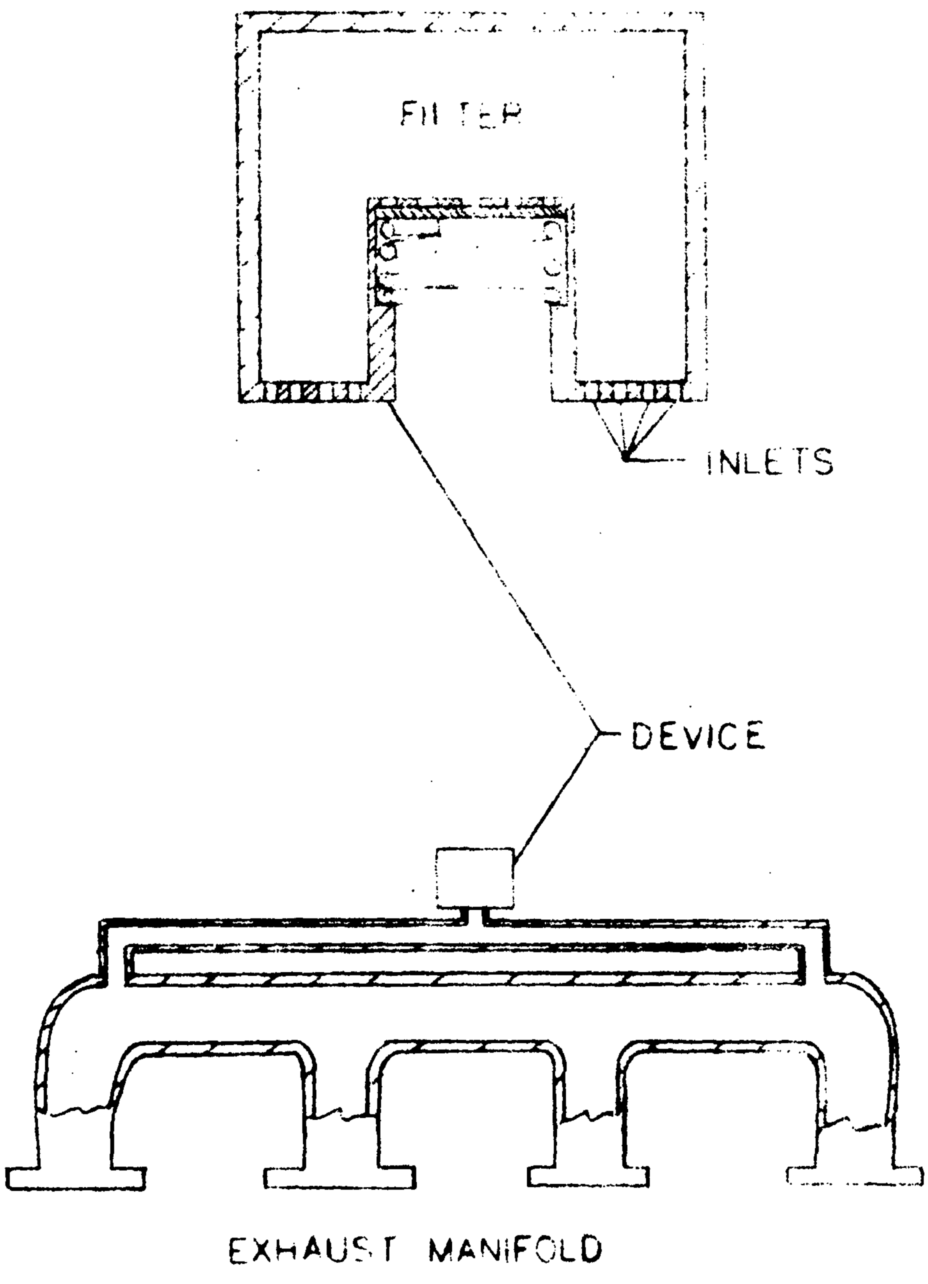

FIGURE 1

INTERPRETED VIEW

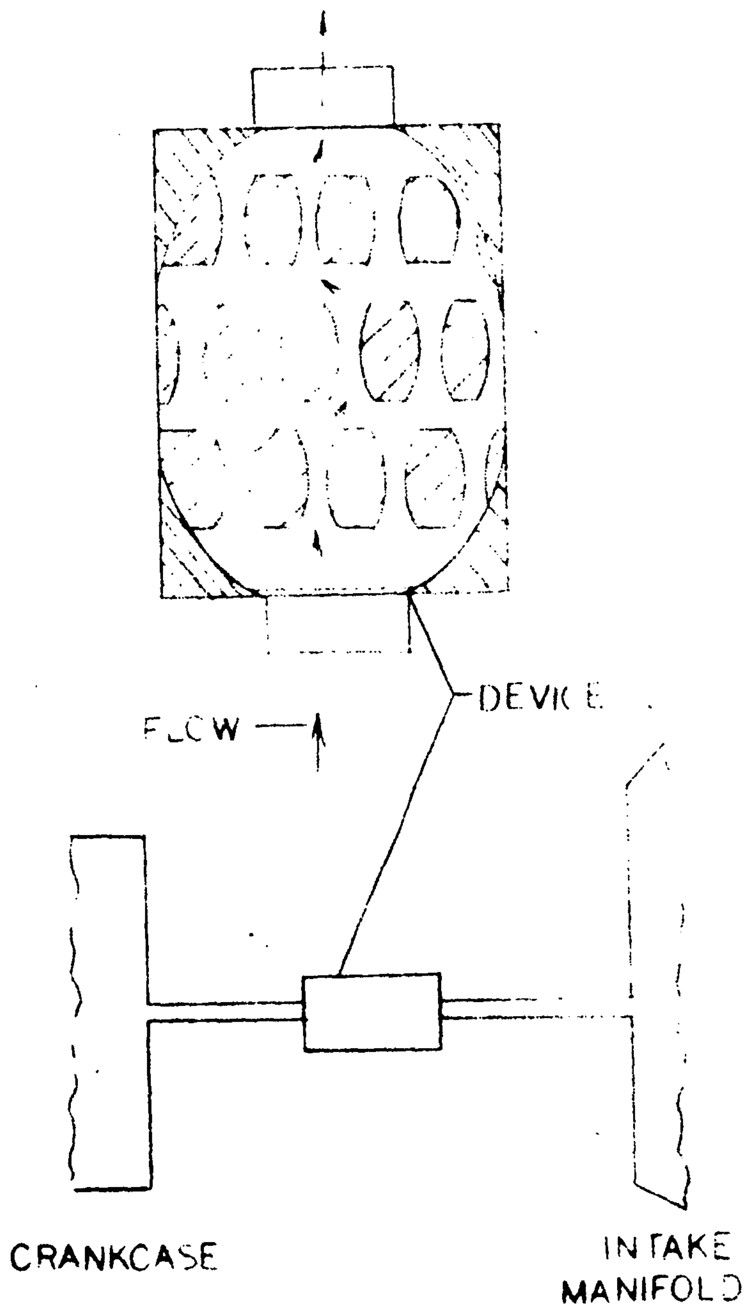

FIGURE 2

INTERPRETED VIEW

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