June 6, 1967 E. MAXWELL 3,323,228

DRYING APPARATUS

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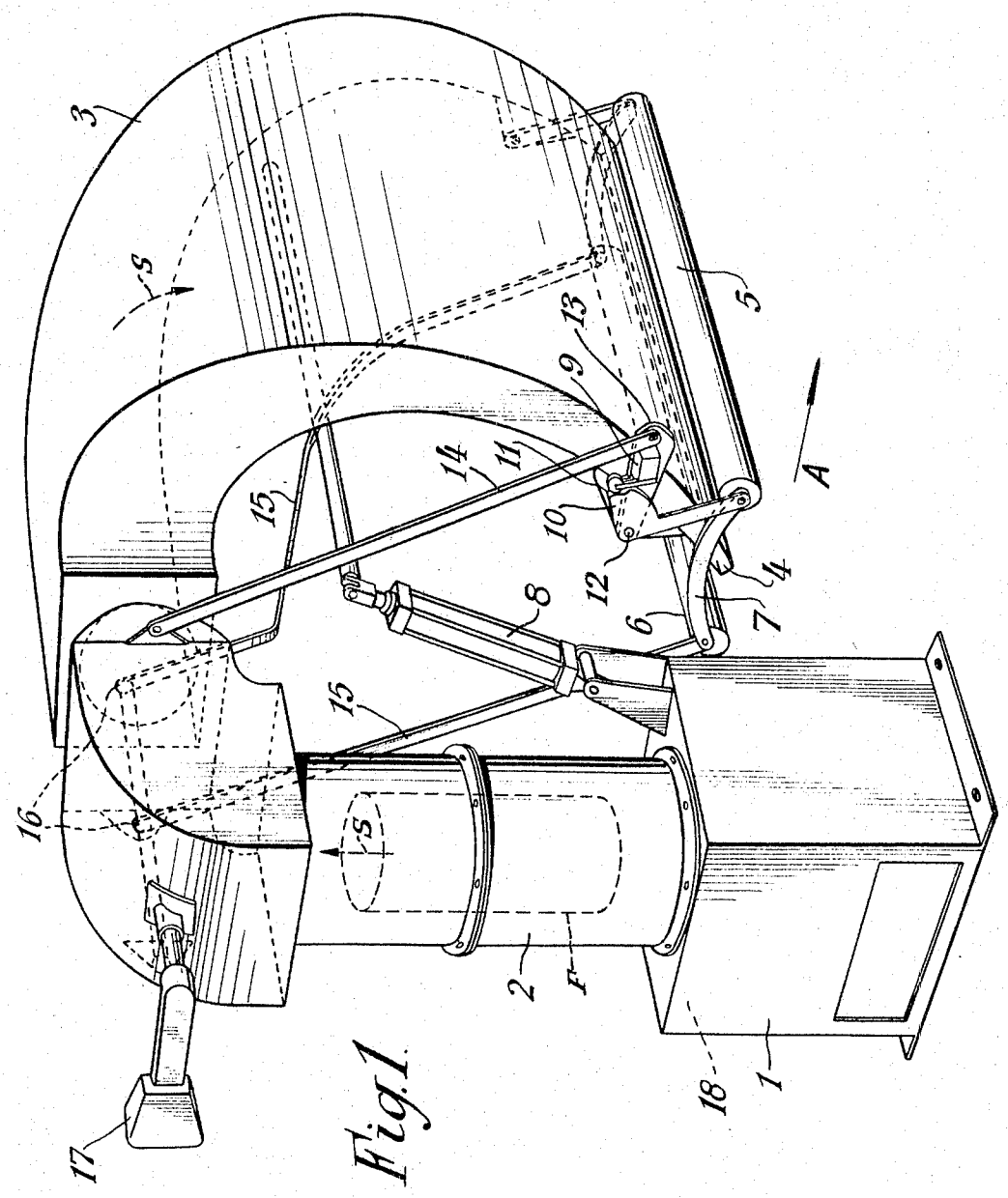


Fig. 1.

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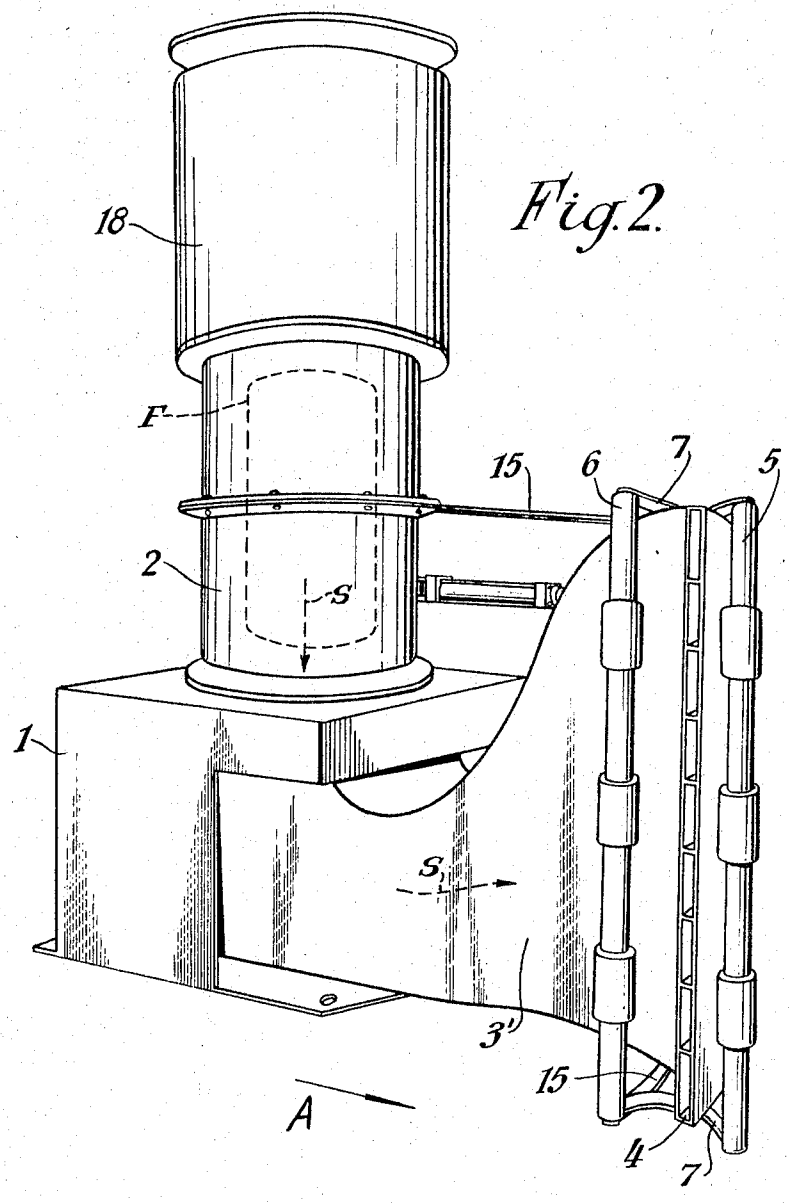
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Fig. 2.



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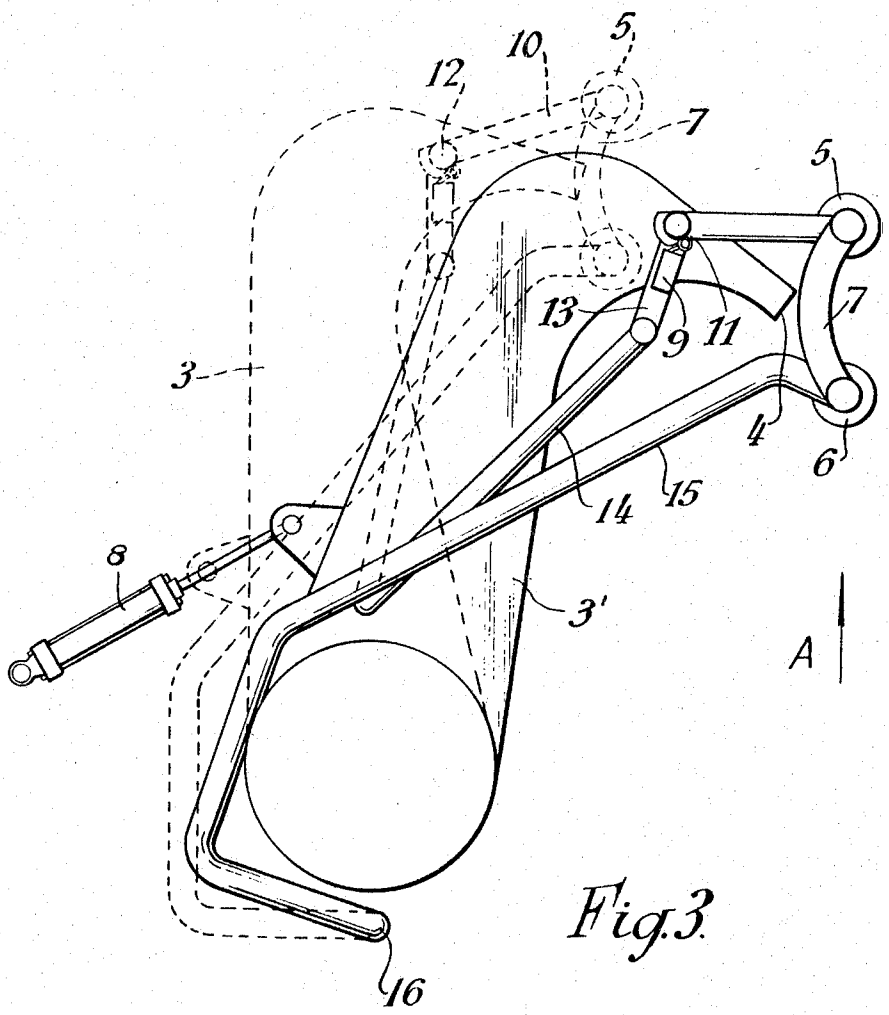


Fig. 3.

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DRYING APPARATUS

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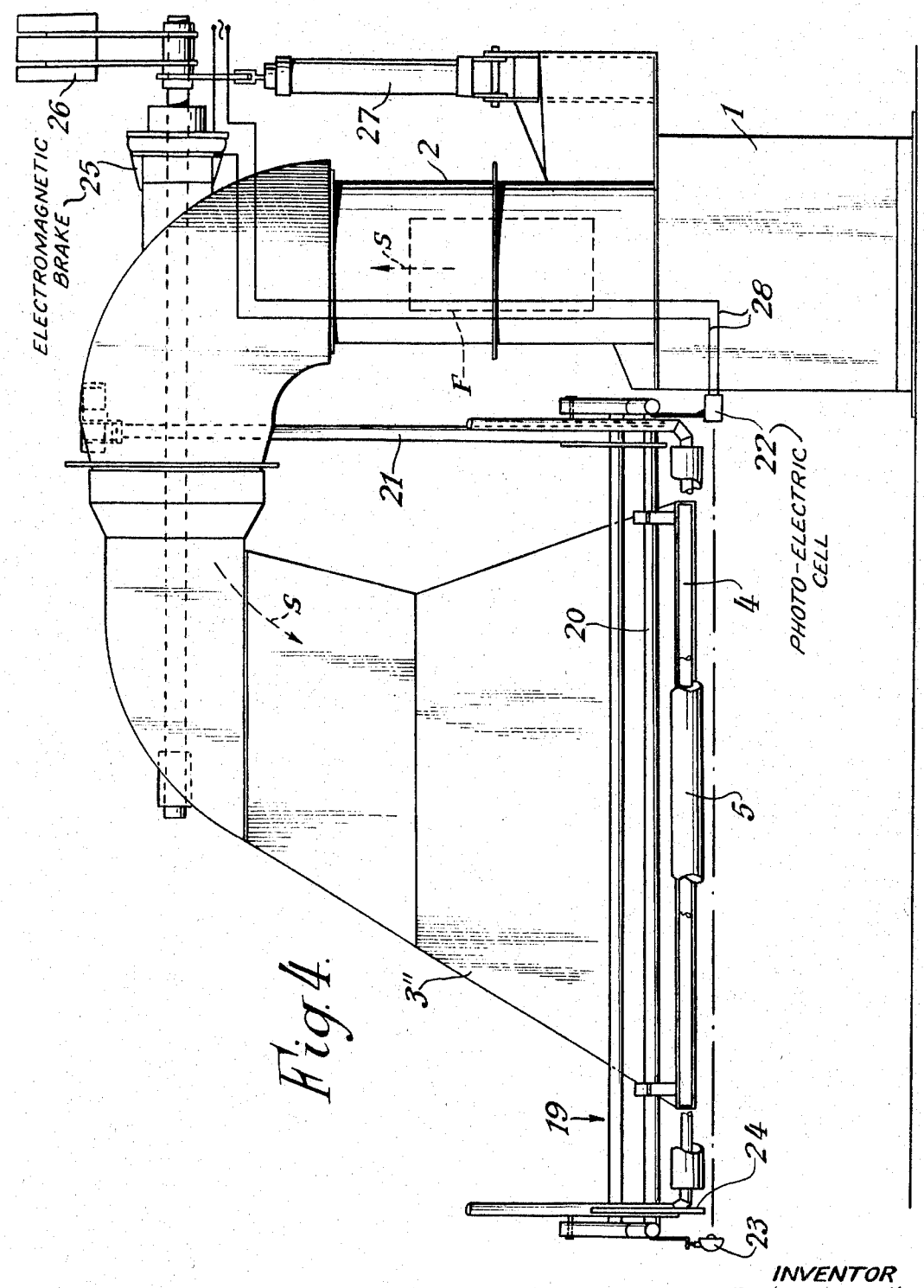


Fig. 4.

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DRYING APPARATUS

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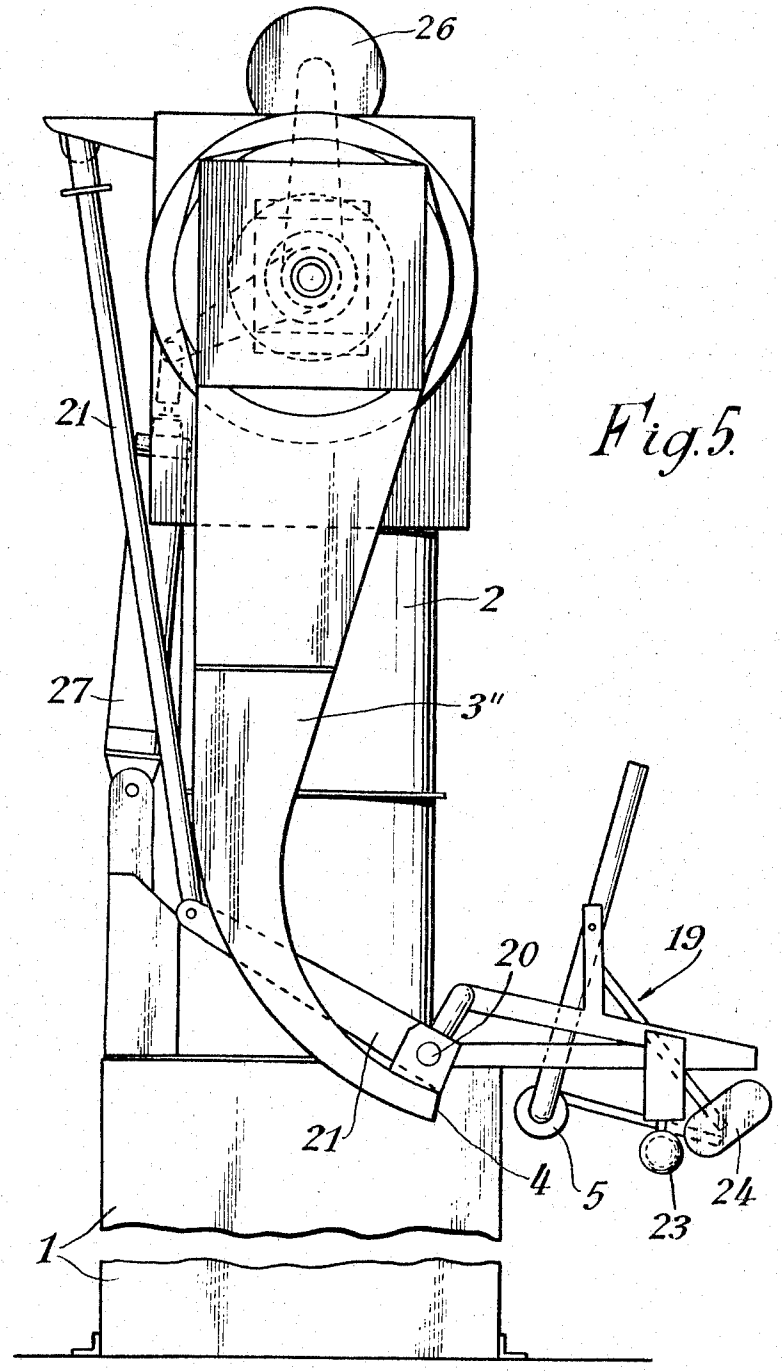


Fig. 5.

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3,323,228

DRYING APPARATUS

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6 Claims. (Cl. 34—229)

This invention relates to an improved form of drying apparatus of the kind in which a stream of air is employed to remove water droplets from a non-absorbent surface. Specifically this invention relates to apparatus for drying the external surface of a vehicle after it has been washed.

Vehicle drying apparatus has been proposed in which means is provided for directing high velocity air streams into a vehicle-receiving drying space of substantially constant size and shape. In this type of apparatus the drying space must be high enough to receive the tallest vehicle and wide enough to receive the widest vehicle which it is anticipated will be dried with the apparatus. Since normally, a range of different sizes of vehicles is processed through a car-washing plant, this means, in practice, that to achieve optimum drying of small vehicles more powerful means must be provided on the apparatus for generating the air streams than would be required if the apparatus were to be used solely for drying the largest vehicles for which it was designed.

This invention relates to drying apparatus in which the dimensions of the vehicle-receiving drying space are automatically adjusted in relation to the size of the vehicle being dried.

According to the invention vehicle drying apparatus comprises at least one unit having an air duct terminating in an outlet nozzle, means for expelling air through the nozzle, sensing means disposed, in the direction of air flow through the nozzle, forwardly of the nozzle and adapted to sense the proximity of the external surface of a vehicle to the nozzle during relative movement of the vehicle past the nozzle and means operatively coupled to the sensing means for controlling the movement of the nozzle so that the nozzle closely follows the contours of the external surface of the vehicle during at least a part of said relative movement.

In a preferred form of drying apparatus in accordance with the invention, three units are employed, one positioned above the vehicle (hereinafter referred to as the "top unit") and one positioned on each side of the vehicle (each hereinafter referred to as a "side unit"). The outlet nozzle of each unit is conveniently slit-shaped, with the narrow dimension substantially at right angles to the direction of said relative movement of the vehicle past the nozzle, the nozzle of the top unit being substantially horizontal and the nozzle of each side unit being substantially vertical.

The means for expelling air through the nozzle of each unit is preferably an electrically powered fan or blower mounted in the air duct with the duct tapering towards the outlet nozzle.

The sensing means of each unit may embody one or more resilient rollers extending the entire width of the duct at the outlet nozzle. Alternatively, resilient rollers may be used in combination with a photo-electric sensing means.

Two specific forms of vehicles drying apparatus in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of the top unit of a first form of apparatus,

FIGURE 2 is a perspective view of the side unit of the first form of apparatus,

FIGURE 3 is a diagrammatic illustration of the manner in which the air duct of the side unit of FIGURE 2 moves in response to the passage of a vehicle therepast.

FIGURE 4 is a front elevation of the top unit of a second form of vehicle drying apparatus, and

FIGURE 5 is a side elevation of the unit of FIGURE 4.

Both forms of apparatus illustrated, are designed to be mounted on a level surface and both comprised a top unit, a near-side unit and an off-side unit (only the top unit has been illustrated in the second form of apparatus). In each form of apparatus the near-side unit and the off-side unit are disposed in spaced-apart relationship on opposite sides of a vehicle driveway so that the air stream from each side unit is directed across the driveway. The top unit is in each case disposed with its air duct above the driveway so that the air stream is directed downwardly onto the driveway.

Referring now to the embodiment of FIGURES 1 to 3, each unit comprises a supporting base **1** and an upstanding cylindrical casing **2** housing a two-stage axial-flow fan F, schematically indicated, and producing an air stream as indicated by the arrows S. The casing **2** is connected to a pivotally mounted air duct **3** which tapers to a slit-shaped air outlet nozzle **4**. The outlet nozzle **4** of each side unit extends at right angles to the surface of the driveway and the outlet nozzle **4** of the top unit extends parallel to the surface of the driveway. The pivoting axis of the duct **3'** of each side unit is directed vertically and the pivoting axis of the duct **3** of the top unit is directed horizontally.

Each unit includes a silencer **18** which, in the case of each side unit is mounted on top of the casing **2**, and in the case of the top unit is located in the base **1**.

Each unit comprises a pair of sensing rollers **5** and **6** disposed in parallel spaced-apart relationship and connected together at each end by arcuate links **7**. The sensing rollers **5** and **6** are mounted on each side of the respective nozzle **4** in the direction of travel of a vehicle along the driveway and each roller is, in the direction of air flow therethrough, mounted forwardly of the nozzle.

Each unit also comprises a pivotally mounted pneumatically-operated cylinder **8** which is coupled between the air duct **3** or **3'** and a fixed part of the unit (i.e. the casing **2** in the case of each side unit and the base **1** in the case of the top unit), and a pneumatic valve **9** for controlling the supply of compressed air to the cylinder **8**. The assembly of linked sensing rollers **5** and **6** is connected to the air duct **3** or **3'** by a support arm **10** pivotally secured to the shaft of roller **5** and having a valve-actuating cam-surface **11** formed thereon. The support arm **10** is pivoted to the air duct **3** or **3'** about a pivot pin **12**. The valve **9** is secured to a valve mount **13**, also pivoted about the pin **12** at one end, and rotatably linked to a controlling stay **14** at the other end. The assembly of linked sensing rollers **5** and **6** is pivotally coupled at each end to a supporting stay **15**, each stay **15** being pivotally secured at **16** to a fixed part of the unit.

The arrangement of linked sensing rollers **5** and **6**, pivoted stays **14** and **15**, pivoted support arm **10** and pivoted valve mount **13** is such that if undisturbed, the plane defined by the axes of the rollers **5** and **6** of each unit in one position of the duct **3** or **3'** parallel to the plane defined by the rollers in any other position of the duct **3** or **3'** and that irrespective of the position of the duct **3** or **3'**, the valve **9** engages the same area of the cam surface **11** when the rollers are undisturbed.

If the assembly of rollers **5** and **6** is disturbed by the

roller 6 being pushed towards the nozzle 4, the cam surface 11 moves relative to the valve 9 and causes the cylinder 8 to pivot the duct 3 or 3' in an attempt to reduce the force displacing the roller 6. Movement of the duct 3 or 3' will continue until force on the roller 6 is removed and the roller 6 returns to its undisturbed position. The duct 3 or 3' of each unit is biased so that if the respective sensing rollers are not displaced from their undisturbed positions, the ducts move slowly across or towards the vehicle driveway. In the case of the top unit, this bias is obtained by providing a counter-weight 17 which leaves a residual gravitational turning moment acting on the duct 3, and in the case of each side unit, this bias is obtained by arranging the pneumatic system so that the cylinder 8 slowly urges the duct inwardly across the driveway when the rollers 5 and 6 are in their undisturbed positions.

The mode of operation of the apparatus is as follows. Let it be assumed that the nozzle 4 of the top unit is in its lowest position and the nozzles of each side unit are in their positions of closest approach, and that a vehicle is driven slowly past the units along the driveway in the direction of the arrows "A." With the fans operating, the front of the vehicle moves towards the three nozzles which are defining a vehicle-receiving space too small for the vehicle to pass through, and eventually a portion of the front of the vehicle strikes each of the rollers 6, with the result that the rollers 6 are tilted from their undisturbed positions. The nozzles retract from the vehicle until each is disposed a short distance away from the adjacent surface of the vehicle. The biasing of the ducts has the effect of tending to urge them to reduce the vehicle-receiving space, a tendency which is prevented, during the passage of the vehicle past the nozzle of the respective duct, by the periodic contact of the sensing rollers 5 and 6 with the adjacent surface of the vehicle. As the vehicle moves through the apparatus the nozzle of each unit closely follows the contour of the adjacent surface of the vehicle so that highly efficient drying is obtained. As the vehicle leaves the apparatus the ducts of the side units close together and the duct of the top unit drops in preparation for the passage of the next vehicle.

Referring now to the embodiment of FIGURES 4 and 5, the top unit illustrated comprises a supporting base 1 and an upstanding casing 2 housing a two-stage axial-flow fan F, schematically indicated and producing an air stream as indicated by the arrows S. The casing 2 is connected to a pivotally mounted air duct 3'' with tapers to a slit-shaped air outlet nozzle 4. Mounted on the duct 3'' and extending forwardly of the nozzle 4 is a sensing means generally designated 19. The sensing means 19 is mounted on a bar 20 pivotally attached to the duct 3'' adjacent to the nozzle 4 and the bar 20 is coupled to the casing 2 via a linkage 21. The linkage 21, ensures that as the duct pivots, the sensing means 19 maintains its orientation relative to a horizontal plane.

The sensing means 19 embodies two distinct elements for sensing the proximity of the external surface of a vehicle, the normal sensing element is formed by a photo-electric cell 22 and a light source 23 which generates a beam that impinges on the cell 22. The second sensing element which also embodies the cell 22, is formed by the roller 5 movably mounted on the sensing means 19 and coupled to a shutter 24.

The pivoting shaft of the duct 3 is connected to an electromagnetic brake 25 and a counterweight 26. During operation of the unit, the reaction caused by air flowing out of the nozzle 4, exerts a thrust on the duct 3 which urges the duct in a clockwise direction as shown in FIGURE 5. The duct 3'' is counterweighted so that the gravitational force due to the weight of the duct is less than the lifting force due to the reaction to air flow, with the consequence that when the unit is being operated, the duct is subjected to a turning moment tending to cause the nozzle 4 to rise. Pivoting of the duct 3'' is prevented by the brake 25.

The electromagnetic brake 25 can be adjusted to two limit positions, one position preventing pivoting of the duct 3'' (and hereinafter referred to as the "fully-on" position) and a second position partially freeing the brake and allowing slow pivoting of the duct (hereinafter referred to as the "partially-on" position).

The photo-electric cell 22 is incorporated into the supply circuit 28 for the electromagnetic brake 25, it being arranged that when the cell 22 is illuminated by the source 23 the brake is held in the fully-on position, but that when the light beam from the source 23 is obstructed, the brake 25 moves into the partially-on position. As the duct 3'' pivots and the nozzle 4 rises, the sensing means 19 rises too thus lifting the beam to the cell 22 away from the object which caused the obstruction. It will be appreciated, therefore, that as a vehicle moves towards the unit the duct 3'' will rise whenever the light beam is obstructed by a part of the vehicle and will continue to rise until the obstruction has been cleared. By suitably adjusting the rate of rise of the duct, relative to the rate of advance of the vehicle, the unit can be set so that the nozzle closely follows the contour of the external surface of the vehicle.

In order to protect against the possibility of the light beam not being sufficiently obstructed by an object (e.g. by a slender object or a transparent object) the second sensing element is provided. If an object manages to pass through the light beam without causing the duct to lift, the object will eventually engage the roller 5 to move the shutter 24 into the light beam and thus initiate a lifting movement.

In practice, the unit would be employed in association with trip mechanisms (which may also be photo-electric) to start the fans on the approach of a vehicle and to lower the duct after a vehicle has passed. This lowering of the duct may be effected merely by switching off the fans, deenergising the brake 25 and allowing the duct to droop downwardly under the influence of gravity. There are advantages however, in pulling the duct 3'' down into its initial (and lowermost) position with a pneumatic cylinder 27.

The specific descriptions given above are but two examples of apparatus in accordance with the invention and many modifications could be made to the apparatus described. In particular it can be pointed out that although pneumatic control of the movements of the ducts is convenient, hydraulic control can be employed equally effectively, and in the case of hydraulic control the more refined forms of hydraulic control valves available make it possible to control more sensitively positions of the ducts, so that for example, in the first form of apparatus, it is possible for the respective assemblies of rollers to continuously engage the surface of the vehicle during a drying operation. This greater sensitivity of control with an hydraulic system, arises because control valves can be employed which adjust the speed of movement of the relative ducts in response to the extent to which the rollers are displaced from their undisturbed positions.

What is claimed is:

1. Vehicle drying apparatus comprising support means, air duct means having an outlet nozzle at one end and being movably mounted on said support means, fan means communicating with the other end of said air duct means for blowing air through said outlet nozzle onto a vehicle passing by said outlet nozzle, said air duct means being constructed and arranged on said support means so as to move, during operation of said fan means, in a direction in which said outlet nozzle moves away from the vehicle, vehicle sensing means mounted adjacent said nozzle, in a direction of air flow through the nozzle, forwardly thereof, and brake means connected to said air duct means to arrest movement of said air duct means in said direction, said sensing means cooperating with said brake means so as to render the latter ineffective when

close proximity of said nozzle to a vehicle is sensed by said sensing means.

2. Vehicle drying apparatus as defined in claim 1, wherein said air duct means is in the region of its other end pivotally mounted on said support means.

3. Vehicle drying apparatus as defined in claim 2, wherein said support means comprises a stationary casing and wherein said fan means is mounted in said casing.

4. Vehicle drying apparatus comprising at least one unit having a casing, fan means within the casing, an air duct movably connected to the casing for pivoting movement about an axis, an elongated nozzle forming the outlet of the duct at that end remote from its point of attachment to the casing, the elongate direction of the nozzle being parallel to the pivoting axis, brake means attached to the casing for impeding movement of the duct about the pivoting axis, a counter weight for balancing the weight of the duct to leave a residual turning moment about the axis due to air flow through the nozzle, sensing means mounted on the duct, disposed in the direction of air flow through the nozzle forwardly of the nozzle, said sensing means comprising at least one roller movably mounted on the duct for movement towards the nozzle, from a rest position to a disturbed position, and control means for the brake means operatively connected to the sensing means for releasing the brake means in a disturbed position of said sensing means.

5. Drying apparatus as claimed in claim 4, in which said brake means is an electromagnetic brake and said sensing means embodies a photoelectric cell in a control circuit to said electromagnetic brake, and a light-source generating a light beam irradiating said cell, said disturbed position of the roller resulting in obstruction of the light beam.

6. Vehicle drying apparatus comprising at least one unit having a casing, fan means within the casing, an air duct movably connected to the casing for pivoting movement about an axis, an elongated nozzle forming the outlet of the duct at that end remote from its point of attachment to the casing, the elongate direction of the nozzle being parallel to the pivoting axis, means attached to the duct for controlling the movement of the latter about the pivoting axis, a photoelectric cell and a light source for irradiating said cell mounted on opposite sides of the duct and aligned with an imaginary line extending in the direction of air flow through the nozzle forwardly of the nozzle and parallel thereto, said photoelectric cell forming part of an electrical control circuit for said means controlling the movement of the duct, whereby when said imaginary line is crossed by an opaque object said duct moves to restore full irradiation of said cell by said light source.

References Cited

UNITED STATES PATENTS

2,321,983	6/1943	Brackett.	
2,904,894	9/1959	Hurst	34—87 X
2,925,801	2/1960	Bivens et al.	
3,224,108	12/1965	Flaming	34—87

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