Title: VEHICLE WHEEL AND WHEEL COVER ASSEMBLY AND METHOD FOR PRODUCING SAME

Abstract: A method for producing a vehicle wheel and wheel cover assembly comprising the steps of: (a) providing a wheel cover having an inner surface and an outer surface; (b) selectively applying at least one shot of a first adhesive material to a portion of the inner surface of the wheel cover to define a predetermined masked area; (c) providing a vehicle wheel having an outboard face; (d) positioning the wheel cover and the vehicle wheel relative to one another whereby at least one cavity is formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material; and (e) selectively applying a second adhesive material to the cavity to secure the wheel cover to the vehicle wheel.
This invention relates in general to vehicle wheels and, in particular, to an improved vehicle wheel and wheel cover assembly and method for producing the same.

Automotive wheels serve two main purposes: the wheels support the vehicle and associated tires and the wheels provide an aesthetically pleasing appearance. Current technology often involves tradeoffs between those two goals. Wheels are typically constructed of metal or metal alloys, although alternative materials, such as composites, are envisioned. The aesthetic appearance of such a wheel is limited by manufacturing methods to form a given styled surface. Additionally, such a wheel will often have excess material (and weight) added to form the styled surface. Wheel clads or covers are used to simulate a styled wheel surface while utilizing a structural wheel underneath to support any loads imparted on the wheel. The wheel cover is typically made of a plastic or thin metal material that is more easily formable into pleasing aesthetic shapes. The cover is then attached to the wheel by mechanical means, whether fasteners, adhesives or locking features formed into the cover or the wheel. The cover can also receive a special surface coating to enhance its appearance, such as a bright paint or chrome plating. It is also desirable that the cover is not easily discernible as separate from the wheel. It is desirable to eliminate evidence of a cover being used such as mating lines, a hollow sound when tapped, yielding to moderate pressure, preventing the entry of foreign matter between the parts and visible wheel surfaces behind the cover. To this end, a suitable adhesive foam
material is often used to deaden the hollow sound when tapped, fill the space between the wheel and cover to prevent entry of foreign matter and support the cover when pressure is applied to the cover.

[0003] It can be very difficult to use adhesives to join the cover and the wheel in a high volume manufacturing environment because the adhesive requires sufficient time for a chemical reaction to occur and expand (in the case of foam adhesives), attain handling strength and subsequently full strength. A fast curing adhesive will allow faster throughput but also cures quickly in the mixing equipment and requires more maintenance. Conversely, a slow curing adhesive possesses a longer open time before clogging inside the dispensing equipment but requires more work-in-process inventory and related resources, such as, floor space, cure ovens, material handling equipment and tooling.

[0004] Furthermore, when using an expanding foam adhesive material, the cover and wheel assembly can be encapsulated inside a masking mold to contain the expanding foam adhesive material. However, there often exists a path internal to the cover and wheel assembly through which it is undesirable to allow the expanding foam adhesive material to enter. It is not feasible to mask off certain areas when the cover and wheel are assembled.

SUMMARY OF THE INVENTION

[0005] This invention relates to a vehicle wheel and wheel cover assembly and method for producing the same.

[0006] According to one embodiment, the method for producing a vehicle wheel and wheel cover assembly comprises the steps of: (a) providing a wheel cover having an inner surface and an outer surface; (b) selectively applying at least one shot of a first adhesive material to a portion of the inner surface of the wheel cover to define a predetermined masked area; (c) providing a vehicle wheel having an outboard face; (d) positioning the wheel cover and the vehicle wheel
relative to one another whereby at least one cavity is formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material; and (e) selectively applying a second adhesive material to the cavity to secure the wheel cover to the vehicle wheel.

[0007] According to another embodiment, the vehicle wheel and wheel cover assembly comprises: a vehicle wheel having an outboard face; and a wheel cover secured to the vehicle wheel, the wheel cover having an inner surface and an outer surface; wherein at least one shot of a first adhesive material is selectively applied to a portion of the inner surface of the wheel cover to define a predetermined masked area prior to selectively applying a second adhesive material to at least one cavity formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material to secure the wheel cover to the vehicle wheel.

[0008] Other advantages of this invention will become apparent to those skilled in the art from the following detailed description of the invention, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is a view of an embodiment of a vehicle wheel and wheel cover assembly.

[0010] Fig. 2 is another view of the vehicle wheel and wheel cover assembly but showing only the first shot of the adhesive/foam material.

[0011] Fig. 3 is a view of the wheel cover illustrated in Figs. 1 and 2, showing the first shot of the adhesive/foam material applied to a portion thereof.

[0012] Fig. 4 is an example of an embodiment of a sequence for producing the vehicle wheel and wheel cover assembly illustrated in Fig. 1.
[00013] Fig. 5 is a schematic diagram illustrated an example of an embodiment of a first step of a process for producing a vehicle wheel and wheel cover assembly.

[00014] Fig. 6 is a schematic diagram illustrating an example of an embodiment of a second step of a process for producing a vehicle wheel and wheel cover assembly.

[00015] Fig. 7 is a view similar to Fig. 3 showing an alternate embodiment of a first shot of an adhesive/foam material applied to a portion of the wheel cover.

DETAILED DESCRIPTION OF THE INVENTION

[00016] Referring now to the drawings, there is illustrated in Figs. 1 and 2 a view of a vehicle wheel and cover assembly, indicated generally at 10, including a first embodiment of a wheel cover retention system, indicated generally at 12. As shown therein, the vehicle wheel and cover assembly 10 defines an axis X and includes a vehicle wheel, indicated generally at 22, and a wheel cover, indicated generally at 30 which as will be discussed below, are secured together. The vehicle wheel 22 may be of any suitable type of material or materials, such as for example, steel, aluminum and alloys thereof, and may be of any suitable type of wheel construction, such as for example, a "full face" type of wheel, such as shown in Fig. 5A of U.S. Patent No. 5,533,261 to Kemmerer, a "bead seat attached" wheel such as shown in Fig. 4 of U.S. Patent No. 5,188,429 to Heck et al., a "well attached" wheel such as shown in Fig. 3 of U.S. Patent No. 5,188,429 to Heck et al., a "bimetal" wheel construction including an aluminum disc and a steel rim such as shown in U.S. Patent No. 5,421,642 to Wei et al., a "modular wheel" construction such as shown in U.S. Patent No. 5,360,261 to Archibald et al., a cast aluminum wheel such as shown in U.S. Patent No. 5,340,418 to Wei, or a euroflange type of wheel such as shown in U.S. Patent No. 5,564,792 to Archibald, the disclosures of all of these patents incorporated by reference in entirety herein.
In the illustrated embodiment the vehicle wheel 22 of the vehicle wheel and cover assembly 10 is a one-piece full cast aluminum wheel and includes a wheel rim, indicated generally at 14, and a wheel disc, indicated generally at 16. The wheel rim 14 includes an inboard tire bead seat retaining flange 14A, and inboard tire bead seat 14B, a generally axially extending well 14C, and outboard tire bead seat 14D, and an outboard tire bead seat retaining flange 14E. Alternatively, the construction, material and/or make-up of the wheel rim 14 may be other than illustrated if so desired.

The wheel disc 16 includes a generally centrally located inner wheel mounting surface or portion 18, an outer annular portion 20, and defines an outer surface or outboard face 22A. The inner mounting surface 18 of the wheel disc 16 is provided with a center hub hole 18A and a plurality of lug bolt mounting holes 18B spaced circumferentially around the center hub hole 18A (one of such lug bolt mounting holes 18B illustrated in Fig. 1). The lug bolt receiving holes 18B are adapted to receive lug bolts (not shown) and nuts (not shown) for securing the vehicle wheel 22 on an axle (not shown) of a vehicle. Also, as shown in this embodiment, the wheel disc 16 further includes a plurality of windows or openings 24 formed therein between each pair of spokes 26. In the illustrated embodiment, the wheel disc 16 includes five window 20, only one of such windows 20 illustrated in Fig. 1 and two of such windows 20 illustrated in Fig. 2 and five spokes 26, only one of such spokes 26 illustrated in Fig. 1. Alternatively, the construction, material and/or make-up of the wheel disc 16 may be other than illustrated if so desired.

In the illustrated embodiment, the wheel cover retention system 12 includes the wheel cover 30 which is secured to the vehicle wheel 22. As will be discussed below, the wheel cover retention system 12 utilizes multiple "shots" of a suitable material, i.e., an adhesive/foam material, dispensed preferably prior to the assembly of the wheel cover 30 and the vehicle wheel 22 and/or after the
assembly of the wheel cover 30 and the vehicle wheel 22. This will allow masking tools to effectively "shut off" areas of the wheel cover 30 and vehicle wheel 22 prior to assembly that are not accessible otherwise.

[00020] In the illustrated embodiment, the wheel cover 30 is preferably formed from plastic and is a one-piece wheel cover and may have at least an outer surface which is painted, chrome-plated or otherwise adorned or decorated as desired. Alternatively, the wheel cover 30 may be formed from other materials, such as metal and/or may be a multi-piece (two or more pieces) wheel cover formed of like or unlike materials if so desired.

[00021] The wheel cover 30 may have an inner surface which closely conforms to the outboard face of the wheel; may have an inner surface which is spaced from the outboard face of the wheel to impart the styling to the wheel; or may have a combination of both an inner surface which conforms and an inner surface which is spaced apart from the outboard face of the wheel. In the illustrated embodiment, the wheel cover 30 includes an inner surface 30A which has portions which generally conform to the outboard face 22A of the wheel 22 and portions which are spaced apart from the outboard face 22A of the wheel 22.

[00022] Also, as best shown in Fig. 3, the wheel cover 30 includes a center hub hole 32, a plurality of lug bolt openings 34, a plurality of window 36, and a spoke 38 provided between each pair of the windows 36. The center hub hole 32 of the wheel cover 30 is preferably adapted to be coaxial with the axis X of the wheel 10 and the center hub hole 18A. The lug bolt openings 34 of the wheel cover 30 are preferably adapted to be coaxial with lug bolt holes 18B of the wheel 22. The windows 36 of the wheel cover 30 generally correspond to or resemble the windows 20 provided in the wheel 22. The spokes 38 of the wheel cover 30 preferably cover the spokes 26 of the wheel 22 and preferably impart a desired styling to the vehicle wheel 22. Alternatively, the construction, material and/or make-up of the wheel cover 30 may be other than illustrated if so desired.
Referring now to Fig. 4, there is illustrated a block diagram illustrating a preferred sequence of steps for producing the first embodiment of the vehicle wheel and cover assembly 10. As shown therein, in step 40 and as illustrated schematically in Fig. 5, the wheel cover 30 is placed face-down onto a lower masking tool (the lower masking tool shown schematically in Fig. 5 by reference number 60), such that the lower masking tool 60 is preferably adjacent the outer surface 30B of the wheel cover 30. As will be discussed below, the lower masking tool 60 is operative to support and locate the wheel cover 30 and prevent a selected adhesive/foam material from contacting the outer "decorative" surface 30B of the wheel cover 30. Also, in step 40, a pre-form tool (shown schematically in Fig. 5 and identified by reference number 62) for the first "shot" of a selected adhesive/foam material is located on the wheel cover 30 preferably adjacent the inner surface 30A thereof and all three parts (the lower masking tool 60, the wheel cover 30, and the pre-form tool 62) are located and clamped together as an assembly as shown schematically in Fig. 5 in step 40.

Next, in step 42, the assembly is preferably allowed to reach a desired controlled temperature (either by external or internal, heating or cooling) and then a suitable adhesive/foam material 54 is selectively dispensed into one or more cavities (one of such cavities shown in phantom in Fig. 5 by reference number 56 defined between the pre-form tool 62 and the wheel cover 30, and the adhesive/foam material 54 is allowed to react. Depending upon the particular adhesive/foam material 54 which is used, step 42 may not require any heating or cooling but may take place at room temperature.

After a desired period of time, next in step 44, the pre-form tool 62 is undamped and the wheel cover 10 is removed having the first shot of the adhesive/foam material 54 selectively adhered thereon in a desired "masking pattern", such as shown for example in the masking pattern shown in the embodiment illustrated in Figs. 2 and 3. As shown in this embodiment, the
adhesive/foam material 54 is preferably generally deposited about an inner circumferential portion of the inner surface 30A of the wheel cover 30. More preferably, the first shot of the adhesive/foam material 54 is selectively adhered around the center hub hole 32 and the lug bolt openings 34 of the wheel cover 30. Alternatively, it is possible that the wheel cover 30 may receive more than one shot or dose of the same or different adhesive/foam materials involving the use of one or multiple pre-form tools depending on the desired masking effect which is to be achieved and/or that the particular areas of the wheel cover 30 which receive the adhesive/foam material may be other than illustrated if so desired. For example, as shown in Fig. 7, step 42 may be operative to deposit an adhesive/foam material 70 on the inner surface of the wheel cover 30 around the lug bolt openings 34. Thus, it can be seen that one or more desired area or areas of the wheel cover 30 may be operatively masked by the selective application of the adhesive/foam material(s) during step 42.

Following this, in step 46, the lower masking tool 60 from the step 42 may be used if desired. In this case, in step 44 as illustrated schematically in Fig. 6, the wheel cover 30 would remain on the lower masking tool 60 and the vehicle wheel 22 is assembled face-down on top of the wheel cover 10, such that the outboard surface 22A of the wheel 22 is preferably adjacent the inner surface 30A of the wheel cover 30. A brake or back side 22B of the vehicle wheel 22 is masked using an upper masking tool (schematically shown in Fig. 6 and identified by reference character 64). The four parts (the lower masking tool 60, the wheel cover 30, the vehicle wheel 22 and the upper masking tool 64) are clamped together and preferably allowed to reach a desired controlled temperature (either by external or internal, heating or cooling). Depending upon the particular adhesive/foam material which is used in the next step, step 48 may not require any heating or cooling but may take place at room temperature.
Next, in step 48, a suitable adhesive/foam material (shown in Fig 1 by reference number 58) is dispensed into one or more cavity areas defined between the cover 30 and the wheel 10 and allowed to react (for discussion purposes, one of such cavity areas indicated by reference number 66 in Fig. 2 and one of such cavity areas also shown in phantom in Fig. 6 by reference number 66). During step 48, the areas between the wheel cover 10 and the vehicle wheel 22 that are not masked properly by the upper and lower mask tools 64 and 60, respectively, are preferably already sealed and filled by the pre-foam shot(s) of material 54 in prior step 42 and thus simplify the upper and lower mask tools 64 and 60, respectively, by eliminating areas of negative draft and removing core-out actuators.

Preferably, during step 48, all the cavity areas between the wheel cover 30 and the vehicle wheel 22 are filled with the suitable adhesive/foam material 58; however, if desired, only some of the such cavity areas may be filled during step 48 if so desired. Following this, in step 50, preferably after a desired period of time, the upper mask tool 64 is undamped and removed and the wheel assembly 10 is removed and packaged for shipment. During storage and shipment the adhesive/foam material(s) 54 and/or 58 is (are) allowed to cure and attain full strength and excess inventory is reduced. Preferably, the adhesive/foam material 58 that fills the cavity areas during step 48 permanently secures the wheel cover 30 to the vehicle wheel 22. Alternatively, other means, such as mechanical retention means, i.e., snap tabs, fasteners and the like (not shown), may be used to assist in positioning the wheel cover 30 relative to the vehicle wheel 22 and/or for permanently securing the wheel cover 30 to the vehicle wheel 2 if so desired.

Alternatively, the method for producing the vehicle wheel and cover assembly 10 may be other than illustrated if so desired. For example, the shot or shots of the adhesive/foam material(s) may be of the same or differing products. Each shot may be and masking tools may be heated and/or cooled as necessary at
any time during the process. The timing between shots can be varied depending on the desired performance of the assembly such as seam lines, cohesive bond strength, appearance and manufacturing considerations. Finally, while the embodiments are illustrated for use in producing a vehicle wheel and cover assembly, it is envisioned that this method may be used in connection with other automotive and non-automotive parts that are joined by an adhesive/foam material (whether expanding foam or other product) and is not easily masked as an assembly. Also, while the first shot of the adhesive/foam material 54 in step 42 is preferably formed directly on the inner surface of the wheel cover to be used, it may be separately formed and secured to the inner surface of the wheel cover by suitable means, such as an adhesive, prior to application of the adhesive/foam material 58 in step 48 or it may be separately formed and secured and/or maintained (i.e., if used as an "insert" masking member which may or may not be secured in place), by the application of the adhesive/foam material 58 in step 48.

[00030] In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been described and illustrated in its preferred embodiments. However, it must be understood that the invention may be practiced otherwise than as specifically explained and illustrated without departing from the scope or spirit of the attached claims.
WHAT IS CLAIMED IS:

1. A method for producing a vehicle wheel and wheel cover assembly comprising the steps of:
   (a) providing a wheel cover having an inner surface and an outer surface;
   (b) selectively applying at least one shot of a first adhesive material to a portion of the inner surface of the wheel cover to define a predetermined masked area;
   (c) providing a vehicle wheel having an outboard face;
   (d) positioning the wheel cover and the vehicle wheel relative to one another whereby at least one cavity is formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material; and
   (e) selectively applying a second adhesive material to the cavity to secure the wheel cover to the vehicle wheel.

2. The method of Claim 1 wherein the first adhesive material in step (b) is selectively applied about an inner circumferential portion of the inner surface of the wheel cover.

3. The method of Claim 2 wherein the first adhesive material in step (b) is selectively applied around a central opening and a plurality of lug bolt openings of the wheel cover.

4. The method of Claim 1 wherein the first adhesive material in step (b) is selectively applied around an outer periphery of the inner surface of the wheel cover.
5. The method of Claim 1 wherein the second adhesive material in step (e) fills the entire cavity formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material.

6. The method of Claim 1 further including prior to step (b) the step providing a masking tool and a pre-form tool and the step of clamping the wheel cover between the masking tool and the pre-form tool to define at least one cavity between the pre-form tool and the wheel cover and during step (b) the step of dispensing the first adhesive material through the at least one cavity to the inner surface of the wheel cover to define the masked area.

7. The method of Claim 1 further including prior to step (e) the step of providing a first masking tool and a second masking tool and the step of clamping the wheel cover between the vehicle wheel and the first masking tool and vehicle wheel between the second masking tool and the wheel cover to define at least one cavity between vehicle wheel and the wheel cover and during step (e) the step of dispensing the second adhesive material to the at least one cavity to secure the wheel cover to the vehicle wheel.

8. The method of Claim 1 further including prior to step (b) the step providing a first masking tool and a pre-form tool and the step of clamping the wheel cover between the masking tool and the pre-form tool to define at least one first cavity between the pre-form tool and the wheel cover and during step (b) the step of dispensing the first adhesive material through the at least one first cavity to the inner surface of the wheel cover to define the masked area and further including prior to step (e) the step of providing a second masking tool and a third masking tool and the step of clamping the wheel cover between
between the vehicle wheel and the first masking tool and vehicle wheel between the second masking tool and the wheel cover to define at least one second cavity between vehicle wheel and the wheel cover and during step (e) the step of dispensing the second adhesive material to the at least one second cavity to secure the wheel cover to the vehicle wheel.

9. The method of Claim 1 wherein the vehicle wheel is a one piece aluminum vehicle wheel and the wheel cover is a one piece plastic wheel cover.

10. The method of Claim 1 wherein the second adhesive material permanently secures the wheel cover to the vehicle wheel.

11. The method of Claim 1 wherein the first adhesive material is molded in-situ on the inner surface of the wheel cover.

12. The method of Claim 1 wherein the first adhesive material is separately formed from the wheel cover.

13. The method of Claim 12 wherein the first adhesive material is secured to the inner surface of the wheel cover.

14. A vehicle wheel and wheel cover assembly produced according to the method of Claim 1.
15. A vehicle wheel and wheel cover assembly comprising:
   a vehicle wheel having a n outboard face; and
   a wheel cover secured to the vehicle wheel, the wheel cover having an inner surface and an outer surface;
   wherein at least one shot of a first adhesive material is selectively applied to a portion of the inner surface of the wheel cover to define a predetermined masked area prior to selectively applying a second adhesive material to at least one cavity formed between the inner surface of the wheel cover, the outboard face of the vehicle wheel, and the masked area of the wheel cover defined by the first adhesive material to secure the wheel cover to the vehicle wheel.

16. The vehicle wheel and cover assembly of Claim 15 wherein the first adhesive material is selectively applied about an inner circumferential portion of the inner surface of the wheel cover.

17. The vehicle wheel and cover assembly of Claim 16 wherein the first adhesive material in step (b) is selectively applied around a central opening and a plurality of lug bolt openings of the wheel cover.

18. The vehicle wheel and cover assembly of Claim 15 wherein the first adhesive material in step (b) is selectively applied around an outer periphery of the inner surface of the wheel cover.

19. The vehicle wheel and cover assembly of Claim 15 wherein the vehicle wheel is a one piece aluminum vehicle wheel and the wheel cover is a one piece plastic wheel cover.
20. The vehicle wheel and cover assembly of Claim 15 wherein the second adhesive material permanently secures the wheel cover to the vehicle wheel.
LOCATE WHEEL COVER BETWEEN UPPER MASK TOOLING AND PRE-FORM TOOLING

DEPOSIT ADHESIVE/FOAM MATERIAL ON WHEEL COVER INNER SURFACE

UNCLAMP WHEEL COVER AND REMOVE PRE-FORM TOOLING

LOCATE WHEEL BETWEEN WHEEL COVER AND UPPER MASK TOOLING AND WHEEL COVER BETWEEN WHEEL AND LOWER MASK TOOLING

FILL CAVITIES BETWEEN WHEEL AND WHEEL COVER WITH ADHESIVE/FOAM MATERIAL

UNCLAMP WHEEL

WHEEL AND COVER ASSEMBLY (FIG. 1)