A wall framing system consists of upper and lower metal channels (12a, 12b), metal studs (13) positioned vertically between the two channels, and fasteners (14) anchoring the studs (13) to the channels (12a, 12b). One or more sheets of wallboard (16) can be attached to the studs (13). The channels (12) contain intermittently spaced fastener holes (27) to allow installation of the studs (13) without having to drill fastener holes (12). One or more holes (44) in the base (21) allow attachment of the channel (12) to a floor or ceiling member without having to drill holes in the channel (12). Markings (30) on the channels (12) allow the positioning of the studs (13) relative to each other without the requirement of measuring distances.
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PERFORATED METAL STUD CHANNEL

Field of the Invention

The present invention relates to the field of wall framing systems, and, more particularly, to systems that use metal channels and metal studs to form a frame upon which wallboard may be fastened.

Background of the Invention

Wall framing systems comprising upper and lower metal channels, and metal studs attached near their ends to the channels, are commonly used in commercial as well as residential buildings. Assembly of such a wall frame includes repetition of a number of small steps. The amount of time a skilled worker spends executing the repetitious acts reflects itself in the cost of the project. The cost of such construction is proportional to the amount of time necessary for a skilled worker to complete all of the steps necessary to installation of the wall. Thus, improvement in efficiency of the workers' time reflects in lower construction costs.

The installation of a metal stud in a metal channel typically requires using a screw gun, such as a Black & Decker model 2038, to drive a fastener through the side of a metal channel and through the side of the stud, thereby anchoring the stud to the channel. Typically, four such fasteners are used for each stud, two near the top end and two near the bottom. The skilled worker must therefore drill through the channel side four times for each stud installed. The time required to drill through the channel side accumulates when many studs are installed, resulting in a significant amount of time spent on this one aspect of the project. In addition, placement of a screw gun against the side of a metal channel often results in the screw slipping laterally prior to...
penetration of the channel. Slippage such as this results in additional time for the installation of studs in a metal channel.

This invention is concerned with reducing the time, and consequently the costs, of constructing a metal wall framing system, by eliminating the skilled worker's repetitive task of screwing fasteners through the channel sides at appropriate locations.

Another repetitive step is the taking of measurements in order to correctly position the studs relative to other studs. Typically, building codes mandate that studs be spaced apart by a standard distance of twelve, sixteen, or twenty-four inches. Distances are measured from the center of one stud when viewing a line longitudinally along the channel to the center of the next stud. Thus, studs placed on sixteen-inch centers, for example, would result in one stud every sixteen inches, regardless of the dimensions of the stud itself. It is not uncommon that an error in measurement results in improper placement of a stud relative to a neighboring stud. Such an error may result in a wall that is weaker than desired if the studs are placed farther apart than the necessary distance. If the studs are placed closer together than the proper distance, the construction project suffers the extra cost of labor in installing more studs than is necessary, as well as the extra cost of materials. If an error of measurement results in a stud that is not properly vertically aligned, more severe problems may occur.

Misaligned studs may create difficulties in positioning of doors, windows, corners, or ends of the wall. Misalignment of studs may also reduce the structural integrity of a wall. The present invention minimizes the likelihood of improper placement or alignment of studs in a wall framing system. It also addresses the costs associated with the time required to properly measure and locate the ends of the studs in the channel.

The installation of the channel also requires drilling through the channel. The task of anchoring a metal channel to a concrete ceiling or floor structure generally consists of using a tool such as a rotohammer, which has the ability to drill into concrete. Such a tool takes a relatively long time to drill through metal channels. Typically, penetrating the metal channel may take forty-five seconds. Avoiding this time further reduces time and costs of installation. In some cases, pins or anchors are driven through the channel without first drilling through the channel. However, driving pins or anchors through the metal channel may result in the pin slipping, bending, or entering the concrete at an angle, and sometimes must be repeated. Also, pins designed to penetrate metal are not optimal for strong anchoring into concrete.
Prior to the present invention, methods of reducing the amount of time skilled workers spend on installation of metal studs focused on speeding up one or more of the steps. Powerful electric screwguns reduced some of the time required for the tasks of drilling holes and fastening screws. Although savings and efficiencies have been achieved, the tasks of measurement and drilling have remained as significant time and cost factors.

Drilling through metal channels produces much noise, often requiring certain jobs to be performed within prescribed windows of time. Avoiding such drilling reduces the noise levels during installation of a wall, resulting in less interference with people in the work area. It also serves to protect the workers from hearing loss.

Summary of the Invention

The present invention provides a wall framing system of the type that includes an upper and a lower channel and a plurality of studs that are anchored by the two channels. The structure of the system allows attachment of one or more sheets of wallboard to the studs in order to form a wall.

The channels of the invention are U-shaped in cross section. The channel includes a base web and two side flanges extending from the base and bent generally normal to the plane of the base web. The upper channel is attached to a ceiling structure with the side flanges of the channel facing downward. The lower channel is attached to a floor structure so that the longitudinal center axis of the lower channel is in the same vertical plane as the longitudinal center axis of the upper channel. The side flanges of the lower channel face upward, so that the opening of each channel faces the opposing channel. In accordance with the invention, the side flanges of the channel include a plurality of intermittently spaced holes, each one being a fixed distance from its neighboring holes. The spacing of the holes is such that the desired distance between the studs as measured between centers is a multiple of the distance between the holes, as measured between centers.

The holes can be spaced four inches apart, as measured between the centers of the holes. This spacing allows for studs to be placed at the most common spacings of twelve, sixteen, or twenty-four inches. Preferably, the holes are spaced two inches apart. In addition to allowing the common spacings, the closer spacing allows minimal wastage of channel members when channels are cut. Where two-inch spacing is used, a channel beginning can be at any two-inch interval, rather than having to cut off a larger amount to create a beginning on the four-inch mark.

The studs are positioned with one end of each stud inserted within the opening of the upper channel, and the opposite end of each stud inserted within the lower
channel. Fasteners are inserted through the holes in the channel, and attached to the
stud, thereby anchoring each end of the stud to the corresponding channel.

Each channel has markings intermittently spaced along the longitude of the
length of the channel, to serve as guides for the placement of studs. In one
embodiment, one set of markings is spaced the same distance apart as the desired
distance between the studs. Optimally, more than one set of markings is used, with
each set distinguishable from the other. Where multiple sets of markings are
employed, the spacing between each marking of a particular set corresponds to one
possible desired spacing of the studs.

The base of the channel also includes one or more intermittently spaced base
holes, the base holes being used to insert base fasteners in order to attach the channel
to a floor or ceiling structure.

**Brief Description of the Drawings**

The foregoing aspects and many of the attendant advantages of this invention
will become more readily appreciated as the same becomes better understood by
reference to the following detailed description, when taken in conjunction with the
accompanying drawings, wherein:

FIGURE 1 is a perspective view of a wall framing system, showing an upper
channel, lower channel, vertical studs, and a cutout section of wallboard;

FIGURE 2 is a partial sectional view of the present invention showing the
lower channel containing intermittently spaced fastener holes, with studs being shown
that extend vertically from the channel, and a fastener positioned for insertion into a
fastener hole; and

FIGURE 3 is a cross section, taken on line 3--3 of FIGURE 2, of a channel
and a vertical stud, showing the fasteners anchoring the end of the stud to the channel.

**Detailed Description of the Preferred Embodiment**

As seen in FIGURE 1, a wall framing system comprises an upper channel 12a
anchored to a ceiling or other overhead structural member 17 above the floor, a lower
channel 12b anchored to a floor structure 18, and a plurality of metal studs 13, each
stud anchored near the top to the upper channel 12a and anchored near the bottom to
the lower channel 12b. This type of wall framing system can be used for either load-
bearing walls or nonbearing walls. One or more sheets of wallboard 16 can be
fastened to the studs.

The upper and lower channels are U-shaped in their cross section and are
identical except for their orientation and location. As seen in FIGURE 2, the channel
12 includes a base web 21 and two side flanges 22 extending from the edges of the

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base and bent generally normal to the plane of the base. Typically, the width of the base web 21 ranges between 1 5/8 and 12 inches to accommodate standard stud widths. The height of the side flanges 22, and correspondingly the depth of the base, typically range between 1.25 and 4 inches. The thickness of the channel 12 also varies, typically ranging from twelve to twenty-six gauge sheet metal. Channels 12 are typically produced in lengths 10 feet long, though this length can vary as needed.

The metal studs 13 are generally C-shaped in their cross section. A stud 13 includes a base web 23 and two side flanges 24 extending from the edges of the base and bent generally normal to the plane of the base. Some studs additionally have two narrow lips 25, one lip bending inward from each of the flanges and running the entire length of the stud. Typically, the width of the lips 25 is small in comparison with the width of the flanges 24, and the width of the flanges is less than the width of the base web 23.

The upper channel 12a is oriented with its base 21 closest to the ceiling 17 and with the side flanges 22 facing downward, so that the interior 26 of the channel faces downward. The lower channel 12b is oriented with its base 21 closest to the floor 18 and with the side flanges 22 facing upward, so that the interior of the channel 26 faces upward. As can be seen in FIGURE 1, the upper channel 12a and lower channel 12b lie in the same vertical plane. Generally, the upper and lower channels are approximately parallel. In some situations, the upper channel 12a may not be parallel with the lower channel 12b. This may be the case, for example, where the plane of the overhead structural member 17 is not parallel with the plane of the floor 18. Where the upper channel 12a is at an angle with the lower channel 12b, a channel without holes is used as the upper channel.

As can be seen in FIGURE 1, each channel base web 21 has one or more base fastener holes 44 that exist in the channel base prior to installation. A fastener 42 such as a 1/4" x 1 1/4" anchor can be used with a .260 inch hole, though other sizes of fasteners and anchors are consistent with the present invention. In one embodiment, a plurality of base fastener holes 44 are intermittently spaced along the longitude of the base web 21. Alternatively, the base fastener holes 44 are placed in an optimal location for a specific installation. The plurality of base fastener holes 44 may be located along a line parallel to the edge of the channel base. The line may be midway between the two edges of the channel base, or offset between the midpoint and one of the edges. If desired, the base fastener holes 44 can be offset so that they do not lie along a single line parallel to the edge of the base.
Each channel side flange 22 has a plurality of intermittently spaced fastener holes 27 that exist in the channel side flange prior to installation. The distance between fastener holes 27 is constant. The spacing of the fastener holes 27 is such that stud spacing, or the distance 28 between the stud centers, is a multiple of the distance between the fastener holes as measured from center to center. For example, where a twelve-inch stud spacing is desired, fastener hole spacings of one, two, three, four, six, or twelve inches could be used. Having a fastener hole spacing that is a common denominator of the most commonly used stud spacings allows the channel to be used for different spacings of the studs, rather than having to use a different channel 12 for each spacing desired. A fastener hole spacing of four inches allows for the most common stud spacings of twelve, sixteen, or twenty-four inches.

It is advantageous to space the fastener holes 27 two inches apart. Reducing the fastener hole spacing to two inches minimizes the waste when a channel 12 is cut. With a fastener hole spacing of two inches, there is never a need to cut off more than two inches at the beginning of a channel. A smaller fastener hole spacing also provides flexibility where the standard spacing between studs must be modified for placement of a certain stud. This may occur, for example, where a wall ends, where one wall is joined with a second wall normal to the first wall, or where a door is placed within a wall. If a situation arises where a stud must be placed in a position where no fastener hole 27 exists, a fastener hole can be drilled through the channel side flange to accommodate a fastener.

To optimally anchor the studs, the diameter of the fastener holes 27 is closely matched with the diameter of the fasteners 36 that are inserted through the fastener holes. The fastener hole diameter is equal to or slightly larger than the fastener 36 diameter at the point where the fastener passes through the fastener hole 27. By providing a tight fit between the fastener hole 27 and the fastener 36, the ends of the studs 13 will be anchored relative to the channels. Alternatively, larger holes could be used, and the fastener itself be used to reduce the movement of the stud. Alternatively, the channel could have smaller fastener holes 27 that are expanded by the process of inserting the fastener.

As can be seen in FIGURE 2, a channel 12 has markings 30 intermittently spaced along the longitude of the channel. The markings 30 can be on any surface visible after the channel 12 has been fastened to the overhead structural member 17 or floor 18. The markings 30 will be on the outside surface 31 of the channel's side flange 22. This position allows the markings 30 to be visible after the studs 13 are installed. Such visibility allows a skilled worker to position the studs with the
markings 30. Preferably, the markings 30 are placed close to the fastener holes 27. Alternatively, the markings 30 are placed anywhere on the surface of the channel. If desired, the markings 30 may be duplicated upside down, in order to allow easy reading, whether the channel 12 is used as an upper channel 12a or a lower channel 12b.

The spacing of the markings 30 corresponds to the desired stud spacing 28. Spacings commonly used in the industry are twelve inches, sixteen inches, and twenty-four inches. In the preferred embodiment, three different types of markings 30 are used. Each marking corresponds to one of the commonly used stud spacings 28. The three different types of markings 30 must be easily distinguishable from each other. A marking may consist of a number 30, the number corresponding to the stud spacing 28. For example, as can be seen in FIGURE 2, the numbers "12", "16", and "24" can be used as markings 30 corresponding to stud spacing 28 of twelve, sixteen, and twenty-four inches, respectively. Where two or more markings 30 must be in the same place, the combination is shown by multiple numbers 32. If stud spacings of twelve, sixteen, or twenty-four inches are used, the sequence of numbers repeats every forty-eight inches.

The inclusion of markings 30 on a channel 12 is further disclosed in a copending application "Wall Framing System with Stud-Retaining Channel Member," which is commonly assigned with this application and was filed on _____________, 1996 as Serial No. _____________.

The wall is constructed by attaching the upper channel 12a to a ceiling or other overhead structural member 17 with the side flanges 22 projecting vertically downward, attaching the lower channel 12b to the floor 18 with the side flanges 22 projecting vertically upward, so that both channels are approximately parallel to each other, and attaching a plurality of studs 13 to the upper and lower channel members. Each channel is secured by inserting one or more base fasteners 42 in base fastener holes 44 and attaching the base fastener to a floor 18 or an overhead structural member 17. A fastener such as a 1/4" x 1 1/4" anchor could be used with a .260 inch hole, though other sizes of fasteners and anchors are consistent with the present invention. Each stud 13 is secured to the channels 12 by determining the correct fastener hole 27b in the channel side flange 22 to use, inserting the end of the stud 13 within the channel, inserting a fastener 36 through the correct fastener hole 27b, and attaching the fastener to the stud. A second fastener 36 is inserted through the oppositely disposed fastener hole 27d on the opposite side flange 22, and attached to the stud 13. The process is repeated for the opposite channel 12, so that the stud 13
is anchored near both ends. Each end of the stud 13 is attached to a channel 12 in this manner, so that both vertical and horizontal movements of the stud are restricted.

One skilled in the art can appreciate that the ordering of the steps in the method described can be changed within the scope of the invention. For example, the studs 13 can be attached to the channels 12 prior to attaching the channels to the overhead structural member 17 and floor 18.

In the practice of the invention, determining the correct fastener hole 27 for anchoring the stud 13 to the channel 12 is accomplished by finding the next marking 30 of the type corresponding to the desired stud spacing 28. If the previous stud 13 was located at the fastener hole 27 adjacent a marking 30, the next fastener hole 27 that receives a stud is the one adjacent the next marking. If the fastener hole 27 used for the previously installed stud is offset from a marking 30, the same offset is used to locate the fastener hole for installation of the next stud.

Using FIGURE 2 to illustrate an example, if studs are to be placed every twelve inches, and the previous fastener hole 27a used was the first fastener hole after the twelve-inch marking 30, the next fastener hole to be used will be the first fastener hole 27c after the next twelve-inch marking 32. The stud 13 is placed adjacent this fastener hole 27c.

If the upper channel 12a and lower channel 12b are mounted so that a marking 30 on the upper channel is vertically aligned with the same type of marking 30 on the lower channel 12b, alignment of each stud 13 results as long as the studs are in both channels with identical offsets.

Alternatively, markings 30 may indicate the distance from one end of the channel 12. In that case, the worker installing studs must calculate the placement position of each stud 13, using the distances provided by the markings 30.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.
The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A U-shaped channel member for use in a vertical wall structure of the type including a plurality of studs extending between an upper channel and a lower channel, said channel member having a base web and two side flanges extending from said base web and defining along with said base web a channel within which a plurality of stud ends can be received, said side flanges of said channel member including a plurality of intermittently spaced fastener holes that are formed in said side flanges prior to fabrication of a vertical wall, said fastener holes for receiving fasteners that secure the studs, preventing horizontal and vertical movement of the studs relative to said channel member.

2. The channel member of Claim 1, wherein said channel member is fabricated of metal.

3. The channel member of Claim 1, wherein said channel member has a plurality of markings intermittently placed along the longitude of said channel member, each of said markings being positioned for association with one of said fastener holes, the distance between said markings being approximately equal to the desired distance between vertical studs, allowing the studs to be placed without requiring measurement of each stud position.

4. The channel member of Claim 3, wherein said channel member has a plurality of distinctive types of markings, each of said distinctive types of markings including a plurality of markings that are spaced apart from one another by a predetermined stud spacing distance, the stud spacing distances of said plurality of distinctive types of markings being different from one another to allow a choice of distances between studs without requiring measurement of each stud position.

5. The channel member of Claim 1, wherein said base web of said channel member includes at least one base fastener hole for receiving base fasteners, the base fasteners attaching said channel member to a structure.

6. A U-shaped channel member for use in a vertical wall structure of the type having a plurality of studs extending between an upper channel and a lower channel, said channel member having a base web and two oppositely disposed side flanges extending from said base web and defining along with said base web a channel.
within which a plurality of stud ends can be received, said base web of said channel member including at least one fastener hole for receiving fasteners that secure said channel member to a structure, said at least one fastener hole being formed in said base web during manufacture of said U-shaped channel member.

7. A vertical wall structure between a floor and an overhead structural member, comprising:
   a) a U-shaped lower channel having a base web and two oppositely disposed side flanges, said base web of said channel being affixed to a floor, said two side flanges of said channel extending vertically upward, said side flanges having a plurality of intermittently spaced fastener holes arranged so that each of said fastener holes is in alignment with a corresponding one of said fastener holes in the oppositely disposed side flange, said fastener holes being formed in said side flanges prior to attachment of said channel to the floor;
   b) a U-shaped upper channel, having a base web and two oppositely disposed side flanges, said base web of said channel being affixed to a horizontal structural member, said two side flanges of said channel extending vertically downward, said side flanges having a plurality of intermittently spaced fastener holes arranged so that each of said fastener holes is in alignment with a corresponding one of said fastener holes on the oppositely disposed side, said fastener holes being formed in said channel side flanges prior to attachment of said channel to the horizontal structural member;
   c) a plurality of studs each having a base web and two oppositely disposed side flanges, said studs vertically aligned and spaced at intervals, the ends of said studs fitting within said U-shaped upper and lower channels, said studs being placed so that said side flanges of said studs are aligned with said fastener holes of said upper and lower channels; and
   d) a plurality of fasteners passing through said fastener holes of said upper channel and said lower channel, each of said fasteners attaching to one of said studs, thereby securing said stud near the top and near the bottom, preventing both horizontal and vertical movements of said stud ends relative to the channels.

8. The wall structure of Claim 7, wherein said studs are fabricated of metal.
9. The wall structure of Claim 7, wherein said upper and lower channels are fabricated of metal.

10. The wall structure of Claim 7, wherein said upper and lower channels include a plurality of markings placed intermittently along each of said channels, each of said markings being positioned for association with one of said fastener holes, the distance between said markings being approximately equal to the distance between said vertical studs, to allow said studs to be placed without requiring measurement of each stud position.

11. The wall structure of Claim 9, wherein said upper and lower channels include a plurality of distinctive types of markings, each of said distinctive types of markings including a plurality of markings that are spaced apart from one another by a predetermined stud spacing distance, the stud spacing distances of said plurality of distinctive types of markings being different from one another to allow a choice of distances between said studs without requiring measurement of each stud position.

12. The wall structure of Claim 7, wherein said base web of each of said upper and lower channel members includes at least one base fastener hole for receiving base fasteners, the base fasteners attaching each of said upper and lower channel members to a structure.

13. A method of constructing a wall structure between a floor and a horizontal structural member, comprising the steps of:
   a) providing at least two U-shaped elongated channel members, each channel member being preformed to include a base web, a pair of oppositely disposed substantially parallel side flanges, and a plurality of fastener holes at longitudinally regularly spaced intervals in said side flanges;
   b) mounting at least one of said channel members to define an upper channel on a horizontal structural member with said side flanges of said one or more channel members projecting vertically downward;
   c) mounting at least one of said channel members to define a lower channel on a floor with said side flanges of said one or more channel members projecting vertically upward in substantial alignment with said side flanges of said channel members included in said upper channel; and
   d) attaching a plurality of studs to said channel members by placing one end of each of said studs within said upper channel and the opposite end of each of

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said studs within said lower channel, selectively aligning each stud with a fastener hole in a side flange of said upper channel and a fastener hole in a side flange of said lower channel, passing a fastener through each fastener hole with which each said stud is aligned, and securing the fasteners into each said stud so that both horizontal and vertical movements of said studs are restricted.

14. A method of constructing a wall structure between a floor and a horizontal structural member, as claimed in Claim 13, wherein said channel members are preformed to include at least one base fastener hole positioned in said base web, and said method additionally comprises the step of inserting at least one base fastener through selected ones of said base fastener holes and securing said at least one base fastener to a structure to which at least one of said upper or lower channels is mounted.

15. A method of constructing a wall structure between a floor and a horizontal structural member, as claimed in Claim 13, wherein said channel members are preformed to include a plurality of markings intermittently placed longitudinally along each of said channel members, said markings comprising at least one distinct type of marking, each marking being positioned for association with one of said fastener holes, and wherein said method additionally comprises the following steps:
   a) determining a first one of said fastener holes associated with one of said markings of one of said marking types;
   b) counting the number of said fastener holes between said one of said fastener holes and said one of said markings;
   c) passing one of said fasteners through said first one of said fastener holes and into a first one of said studs;
   d) determining a second one of said fastener holes associated with a second one of said markings of said one of said marking types, wherein the number of said fastener holes between said second fastener hole and said second marking is the same as the number of said fastener holes between said first fastener hole and said first marking; and
   e) passing a second one of said fasteners through said second one of said fastener holes and into a second one of said studs.

16. A method of constructing a wall structure between a floor and a horizontal structural member, as claimed in Claim 15, wherein said channel members are preformed to include at least one base fastener hole positioned in said base web,
and said method additionally comprises the step of inserting at least one base fastener through selected ones of said base fastener holes and securing said at least one base fastener to a structure to which at least one of said upper or lower channels is mounted.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) : E04C 3/04; E04H 1/00
US CL. : 52/481.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 52/481.1, 241, 730.7, 731.1, 731.7, 731.8

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5,203,132 A (SMOLIK) 20 APRIL 1993 (20/04/93), SEE ENTIRE DOCUMENT</td>
<td>1-5, 7, 8 AND 10-16</td>
</tr>
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</table>

X Further documents are listed in the continuation of Box C. See patent family annex.

**"*** Special categories of cited documents:
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Date of the actual completion of the international search: 27 MAY 1997
Date of mailing of the international search report: 24 JUN 1997

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3597

Authorized officer: YVONNE HORTON-RICHARDSON
Telephone No. (703) 308-2168

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