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W. A. WHITCOMB

1,624,029

PAPER MAKING

Filed Feb. 28. 1925

3 Sheets-Sheet 1

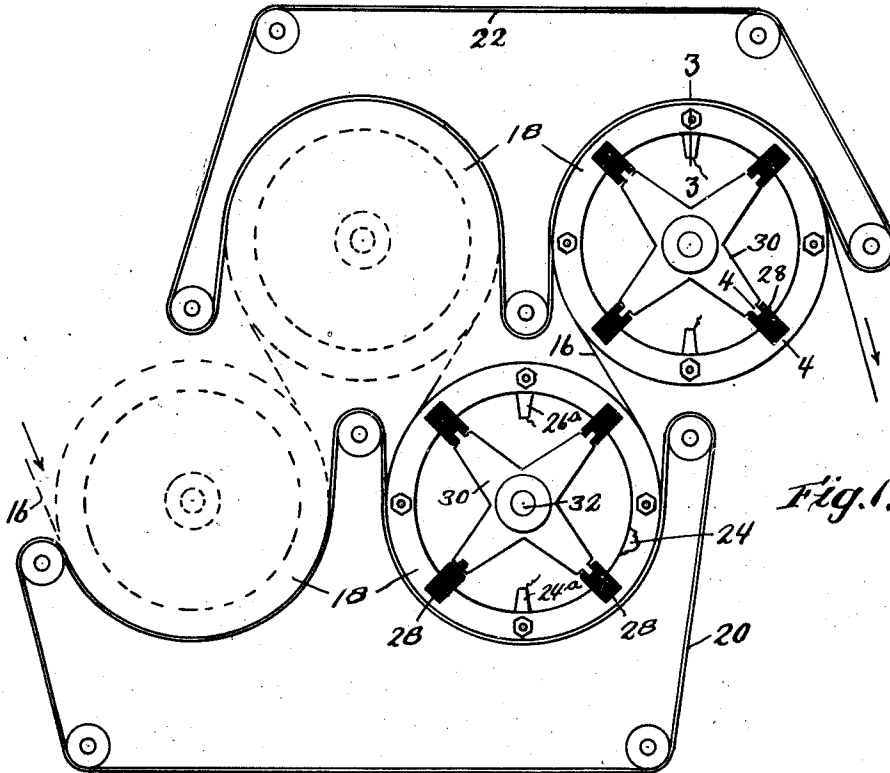


Fig. 1.

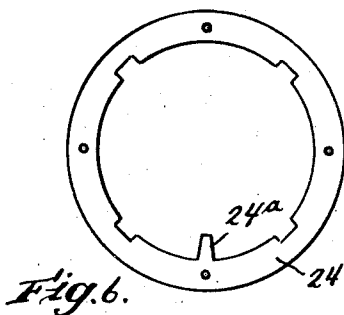


Fig. 6.

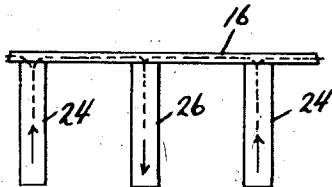


Fig. 5.

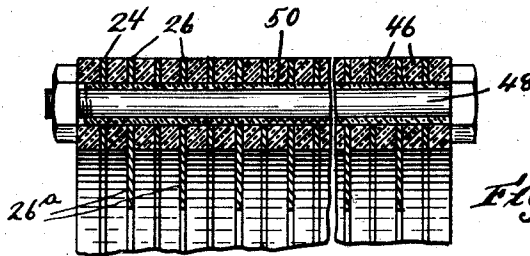


Fig. 3.

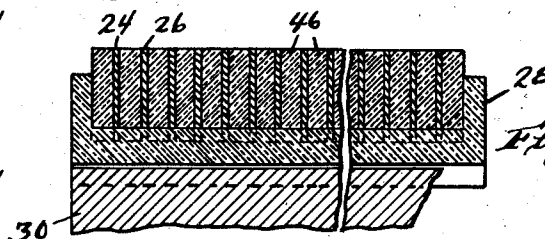


Fig. 4.

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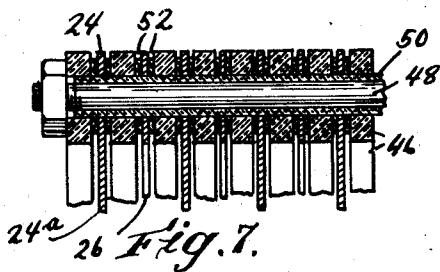
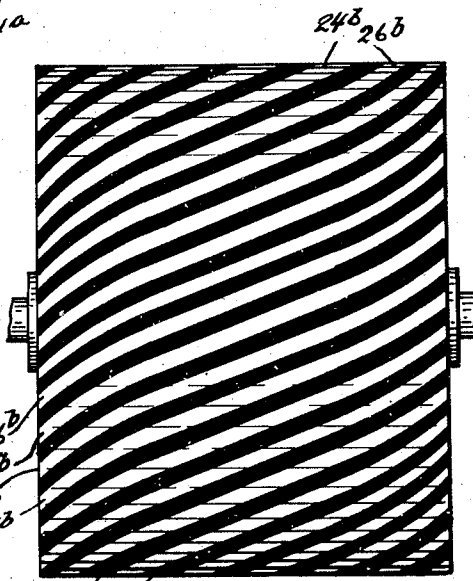
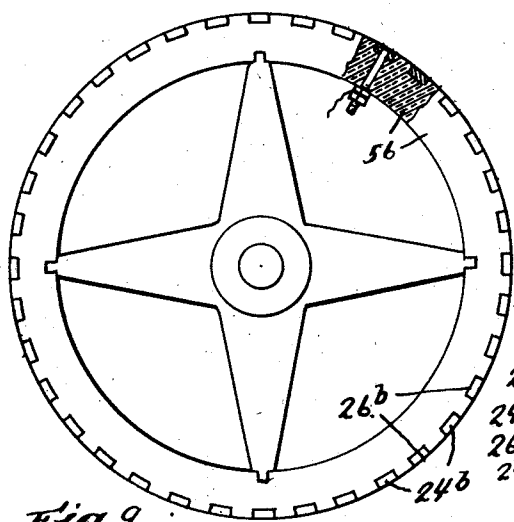
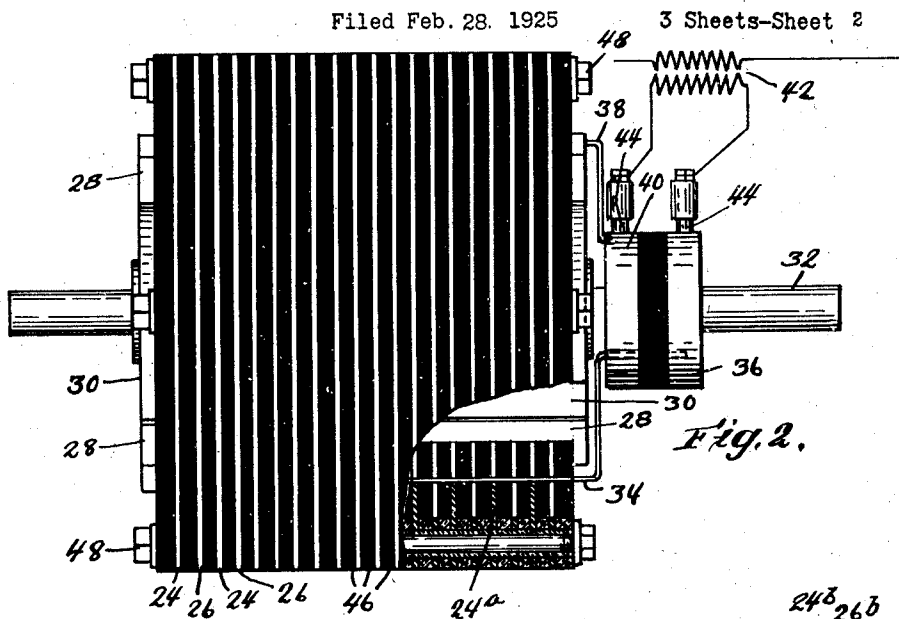
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3 Sheets-Sheet 2



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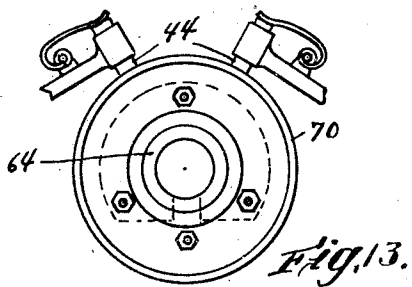
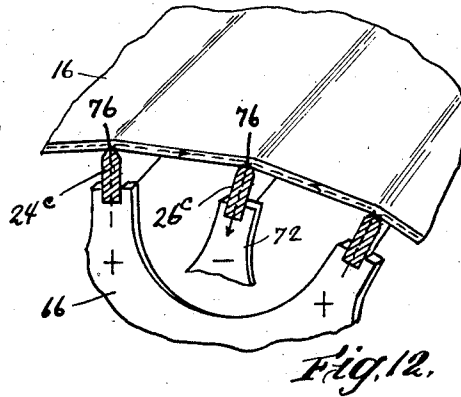
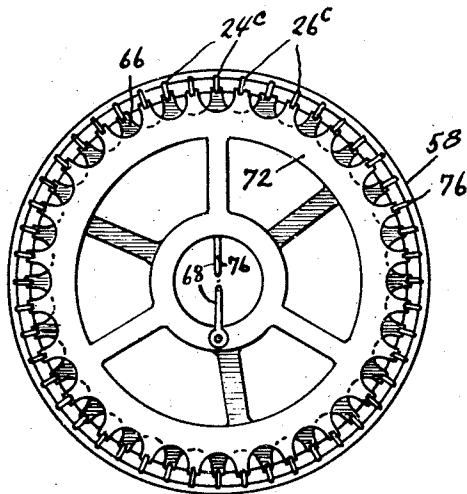
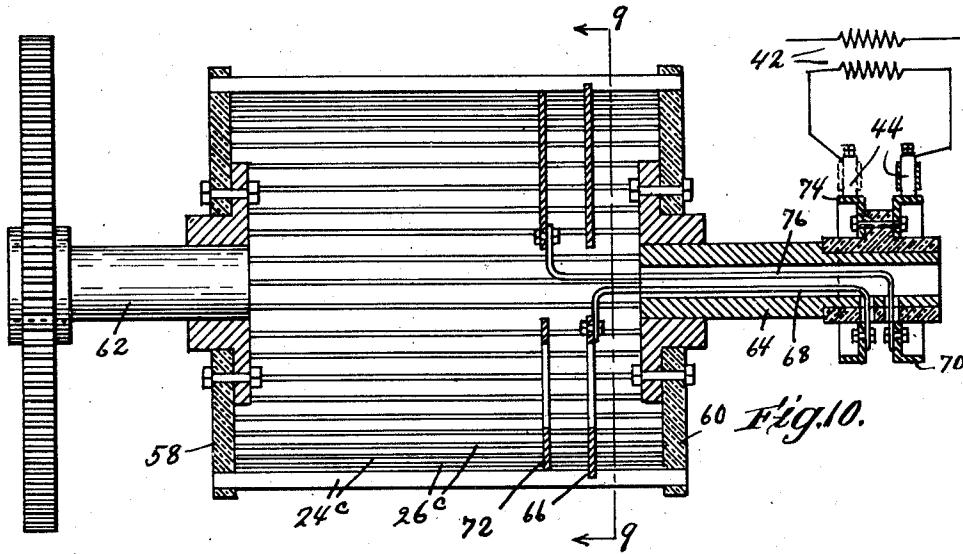
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3 Sheets-Sheet 3

1,624,029



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UNITED STATES PATENT OFFICE.

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PAPER MAKING.

Application filed February 28, 1925. Serial No. 12,414.

This invention relates to paper making and particularly to the drying of the wet paper sheet after it leaves the paper making wire or other sheet forming means, and an object of this invention is the provision of a method and apparatus for drying the wet paper sheet by the generation of heat within the sheet itself.

The paper sheet after it leaves the sheet forming means, is more or less saturated with water. Water, as commercially obtained, has a relatively low electrical resistance and consequently the wet paper sheet is a fair electrical conductor. In carrying out the invention, an electric current of suitable magnitude and at a suitable potential is caused to traverse the wet sheet. Due to the resistance of the water content of the sheet in the current path, the water becomes heated and vaporizes, and the sheet becomes dry.

A further object of the invention is the provision of means to dry the wet paper sheet electrically in a continuous manner as the paper sheet travels through the paper making machine.

In carrying out this object of the invention, the paper making machine is provided with one or more electrical paper-drying rolls about which the wet paper sheet is caused to pass and be supported in contact with a plurality of spaced roll-electrodes of opposite polarity so that a plurality of relatively short conducting paths are formed in the paper sheet, whereby to reduce the potential necessary to cause the requisite drying current to pass through the sheet.

A further object is generally to improve the construction of paper making apparatus and methods.

Fig. 1 is a more or less diagrammatic representation of the drier elements of a paper making machine embodying the invention.

Fig. 2 is a side elevation, partly in section, of an electric drying roll of Fig. 1.

Fig. 3 is a section through the electric drying roll taken along line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3 but taken along line 4—4 of Fig. 1.

Fig. 5 is an enlarged perspective detail illustrating the relation of the paper sheet and the electrodes of the electric drying roll of Figs. 1 and 2.

Fig. 6 is a plan view of one of the electrode rings of the drying roll.

Fig. 7 is a cross-sectional detail illustrating a modified construction of electric drying roll.

Figs. 8 and 9 are side and end elevations respectively of a further modified form of electric drying roll, wherein the electrodes are spirally arranged on the surface of the roll.

Fig. 10 is a longitudinal sectional elevation through another form of drying roll wherein the electrodes are axially arranged on the periphery of the roll.

Fig. 11 is a section along line 9—9 of Fig. 8.

Fig. 12 is an enlarged perspective detail illustrating the relation of the paper sheet and the electrodes of the electric drying roll of Fig. 10.

Fig. 13 is an end detail of the collector rings and brushes of the electric drying rolls illustrated in Figs. 2 and 10.

Fig. 1 illustrates more or less diagrammatically the drying end of a paper making machine embodying the invention. The wet paper sheet 16 coming from the Fourdrinier wire or other sheet forming means, and press rolls, and, if desired, preliminary drying rolls of the ordinary type, not shown, passes over one or more lower and upper drying rolls 18 embodying the invention. Lower and upper felts 20 and 22 may be associated with the upper and lower rolls to support the wet paper sheet in contact with said rolls in the usual manner. The construction and arrangement of these felts is well known and therefor need not be further described.

After passing from the electric drying rolls, the paper sheet may pass either to other driers of any desired type or direct to and through a calender stack, not shown, in the usual manner.

The electric drying rolls embodying the invention may be constructed in a variety of ways without departing from the principle of the invention. The preferred form of electric drying roll is illustrated in Figs. 1 through 6. Said roll is composed of a plurality of electrodes in the form of metal rings 24 and 26, which rings are arranged in alternate, parallel, spaced relation and are supported on a plurality of insulating

blocks 28 from an internally disposed spider 30. Said spider is provided with a shaft 32 which extends beyond the roll in both directions to provide a rotatable support for the roll. Said discs 26 are formed or provided with internally extended lugs 26^a which are arranged in line; and said discs 24 are similarly provided with internally extended lugs 24^a which also are arranged in line and are diametrically opposed to the lugs 26^a. Said rings 24 and 26 may be identical in construction, and may be as illustrated in Fig. 6, and may be assembled in the roll so that the lugs of the discs are disposed alternately on diametrically opposed points of the roll. All of said lugs 24^a are adapted to be connected electrically to a conductor 34 which, in turn, is connected to a collector ring 36 carried by the shaft 32. All of said lugs 26^a are similarly connected together and to a conductor 38, which conductor is connected to a second collector ring 40. Current at a suitable potential may be supplied to said rings from a suitable power source as the transformer 42 through brushes 44 bearing upon said collector rings. The wet paper sheet is adapted to be supported in contact with the periphery of said electrode rings for as large an extent of the periphery thereof as is practicable. Due to the alternate spacing of said electrode rings, a plurality of relatively short current conducting paths are formed through the wet paper sheet as illustrated in Fig. 5.

Due to the current passing through the wet paper sheet and the resistance of the water content of the paper sheet, the water becomes heated and is vaporized and driven off, thereby effecting the drying of the paper. Since the heating current passes through the paper sheet, the drying action proceeds simultaneously within the entire thickness of the sheet. As the rings are always in contact with the sheet, the circuit between the rings and through the sheet is never interrupted so long as there is a sheet on the roll, so that there is no danger of damage to the sheet due to possible arcing. Preferably said rings are relatively thin so that their lines of contact with the upper sheet are relatively narrow and do not materially shield the paper sheet from the heating and drying action.

Preferably the interstices between said discs are filled in with some suitable insulating material as the insulating rings 46 so that the periphery of the drying roll is smooth and is adapted to support the paper sheet throughout substantially its entire width. Said electrode rings and insulating rings may be suitably secured together by means of tie-bolts 48 which pass through said rings and are insulated from said electrode rings by the insulating tubes 50.

For some purposes, I may prefer to provide narrow passages between the insulating rings and said electrode rings so that said insulating rings are out of contact with said electrode rings for the greater part of their peripheral extent. Such a construction is illustrated in Fig. 7 where clearance slots 52 are provided between the insulating rings and the electrodes by means of the insulating spacing discs disposed on said insulating tubes 50 between said insulating rings and electrodes. Preferably the axial extent of said slots 52 is relatively small so that the paper will be adequately supported throughout its width.

Figs. 8 and 9 illustrate a modified form of electric drying roll wherein a plurality of spaced electrodes 24^b and 26^b are arranged in a more or less spiral form about and imbedded in the periphery of an insulating cylinder 56. Alternate electrodes may be connected electrically together and to a suitable source of electric power in any desirable manner not necessarily shown.

In the modification shown in Fig. 10, the electrodes comprise a plurality of axially-disposed and peripherally arranged bars 24^c and 26^c, which bars are secured at their ends to insulating discs 58 and 60 carried by the shafts 62 and 64. The bars of said two sets are alternately arranged around the periphery of the roll and alternate bars as the bars 54 are connected electrically to a metal disc 66, which disc in turn, is connected to a conductor 68 and a collector ring 70 carried by the shaft 64. The other set of bars 26^c is connected electrically to a similar disc 72, which disc is connected to a second collector ring 74 by means of a conductor 76. As arranged in this modification, the wet paper sheet 16 is supported upon the top edges of said electrode bars as is more clearly illustrated in Fig. 12 and a plurality of longitudinally-disposed current conducting paths are formed in the paper sheet. Preferably the top edges of said bars are reduced in area as at 76 for the purpose of reducing the area of contact of said bars with the paper sheet.

In addition to the dissipation of moisture in the wet paper sheet, due to the electrical heating thereof, moisture may also be dissipated at the electrodes due to electrolysis of the water, the water breaking up into hydrogen and oxygen in the usual manner.

The conductivity of water varies considerably and depends more or less upon the nature and amount of impurities therein. In some localities and under some circumstances, it may be that the water used to float the pulp stock and thereby present in the wet paper sheet has such a high resistance that an undesirably high potential may be required to effect the proper drying action. Under such circumstances, I may introduce

a suitable amount of an electrolyte in the water whereby to increase the conductivity therein and thereby reduce the potential required for effective drying action.

5 I may provide as many or as few electric drying cylinders as may be found necessary to effect the drying of the paper sheet under specific conditions. I prefer to use two or more drying cylinders and to arrange them
10 in such a manner with respect to each other and to the paper sheet that the lines of contact of the electrodes of the successive cylinders with the paper sheet will fall between the lines of contact of the electrodes on the
15 preceding drying cylinder, or the current paths formed in the paper sheet by the two rolls will overlap, whereby to avoid formation of water streaks in the paper sheet.

The potential of the current must be
20 chosen to suit the work to be done and the conductivity of the sheet and its water content. This may be determined by experiment. The drying proceeds more rapidly at high potentials, and with the use of proper
25 precautions which will be familiar to any electrician a potential of more than 1000 volts may be employed but if the conductivity of the sheet is sufficient it is desirable to use a lower potential.

30 I claim:

1. The method of drying a wet paper sheet which consists in conducting through it an electric current of such value as directly to heat and evaporate moisture in the sheet.

35 2. The method of drying a wet paper sheet which consists in forming the sheet with the aid of an electrolyte, and conducting through the wet sheet an electric current of such value as to heat and dissipate
40 moisture therein.

3. The method of drying a moving wet paper sheet which consists in passing the sheet over and in contact with spaced electrodes and conducting through the moving
45 sheet and between the electrodes an electric current of a magnitude sufficient to dissipate moisture from the sheet by its direct action on the wet sheet.

4. The method of drying a moving wet
50 paper sheet which consists in passing the sheet over and in contact with spaced electrodes, moving said electrodes with the moving sheet and conducting through the sheet and between the electrodes an electric
55 current of a magnitude sufficient to dissipate moisture from the sheet.

5. The method of drying a moving wet paper sheet which consists in passing the paper sheet about a roll having a plurality
60 of peripherally spaced electrodes which support and are in contact with the sheet on the roll, and conducting through the paper sheet between the electrodes an electric current of sufficient magnitude to dissipate
65 moisture from the sheet.

6. A paper drier comprising a roll adapted to support and drive a wet paper sheet and including a plurality of peripherally-disposed and axially-spaced, electrically-conducting rings adapted to engage and support the wet paper sheet, and means to establish a difference of potential between groups of said rings.

7. A paper drier comprising a roll adapted to support and drive a wet paper sheet
75 comprising a plurality of peripherally-disposed and axially-spaced, electrically-conducting rings adapted to engage and support the wet paper sheet, means to connect alternate rings electrically, and means to establish a difference of potential between
80 said alternate rings.

8. A paper making machine comprising the combination of means to establish a plurality of electrically-conducting current
85 paths through a wet paper sheet, and means to pass through said paths electric currents of magnitudes sufficient to effect the heating and dissipation of the moisture in the current paths.

9. A paper making machine comprising the combination of means to establish a plurality of overlapping and electrically-conducting current paths through a wet paper sheet, and means to pass through said paths
95 electric currents of magnitudes sufficient to effect the heating and evaporation of the moisture in the current paths.

10. A paper making machine comprising the combination of means to provide a plurality of successive and overlapping electrically-conducting current paths through a wet paper sheet, and means to pass through said paths electric currents at sufficient magnitude to effect the heating and drying of the
105 wet paper sheet included in said current paths.

11. A paper making machine including two electric drying rolls about which the wet paper sheet is adapted to be supported and passed, each roll having a plurality of spaced peripheral electrodes which electrically engage said wet paper sheet and form a plurality of current-conducting paths through it, said rolls arranged to provide
115 overlapping conducting paths in the wet sheet, means to pass the wet paper sheet about said rolls in succession, and means to pass electric currents through the conducting paths in the wet sheet.

12. An electric paper drier including a pair of spaced electrodes arranged electrically to engage a moving wet paper sheet, and means to maintain the continuity of the electrically conducting path through the
125 moving paper sheet between said electrodes.

13. An electric paper drier including a drying roll having a relatively smooth periphery adapted to support the wet paper sheet throughout approximately its entire
130

width, and a plurality of insulated electrodes arranged about said periphery and forming a part thereof.

14. An electric paper drier including a drying roll having a plurality of peripherally-disposed and spaced electrodes arranged to support and also to electrically engage the wet paper sheet, and other paper-supporting means disposed between said electrodes.

15. An electric paper drier including a drying roll including a plurality of peripherally-disposed and spaced electrodes arranged to support and also to electrically engage the wet paper sheet, and other paper-supporting means comprising insulating members disposed between said electrodes.

16. An electric paper-drying roll includ-

ing a plurality of alternately-disposed insulating and conducting members arranged to provide a smooth and substantially continuous paper-supporting surface, and means to electrically connect alternate conducting members.

17. An electric paper-drying roll including a plurality of alternately-disposed insulating and conducting rings arranged to provide a smooth and substantially continuous paper-supporting surface, and means electrically to connect alternate conducting members.

In testimony whereof, I have signed my name to this specification.

WILLIAM A. WHITCOMB.