Sept. 2, 1969 I. G. CUMMING 3,464,461
ENDLESS BELT FOR PAPER OR BOARD MAKING MACHINE
AND A METHOD OF WEAVING CLOTH THEREFOR
Filed April 28, 1967 4 Sheets-Sheet 1

Fig. 1.

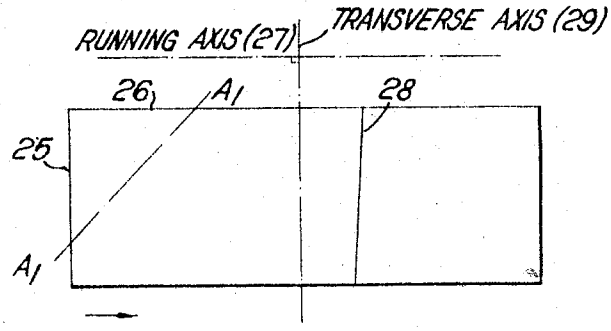
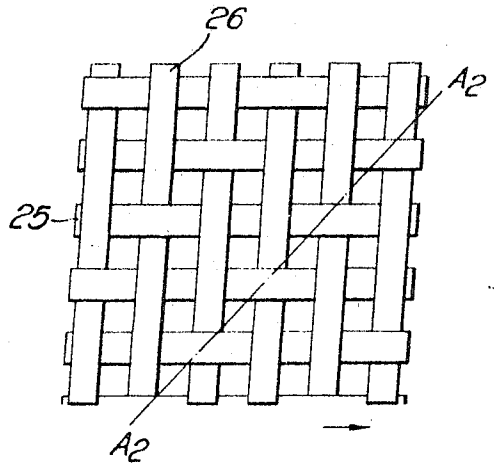


Fig. 2.



Inventor:
IAN GEORGE CUMMING
By Howson & Howson
Attorneys

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Fig. 3.

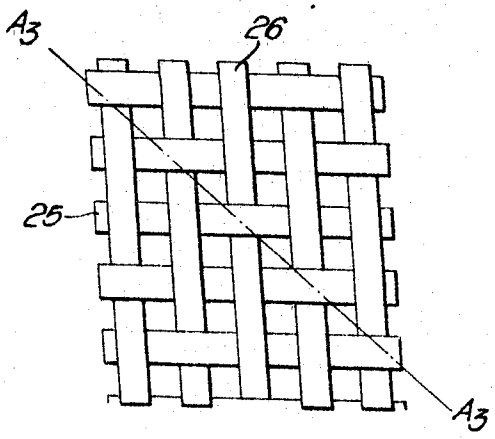
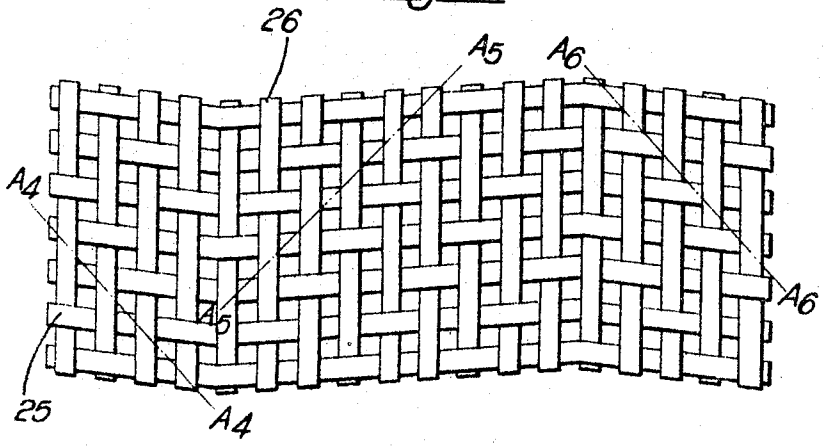


Fig. 4.



Inventor
IAN GEORGE CUMMING
By Howson & Howson
Attorneys

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Filed April 28, 1967 4 Sheets-Sheet 3

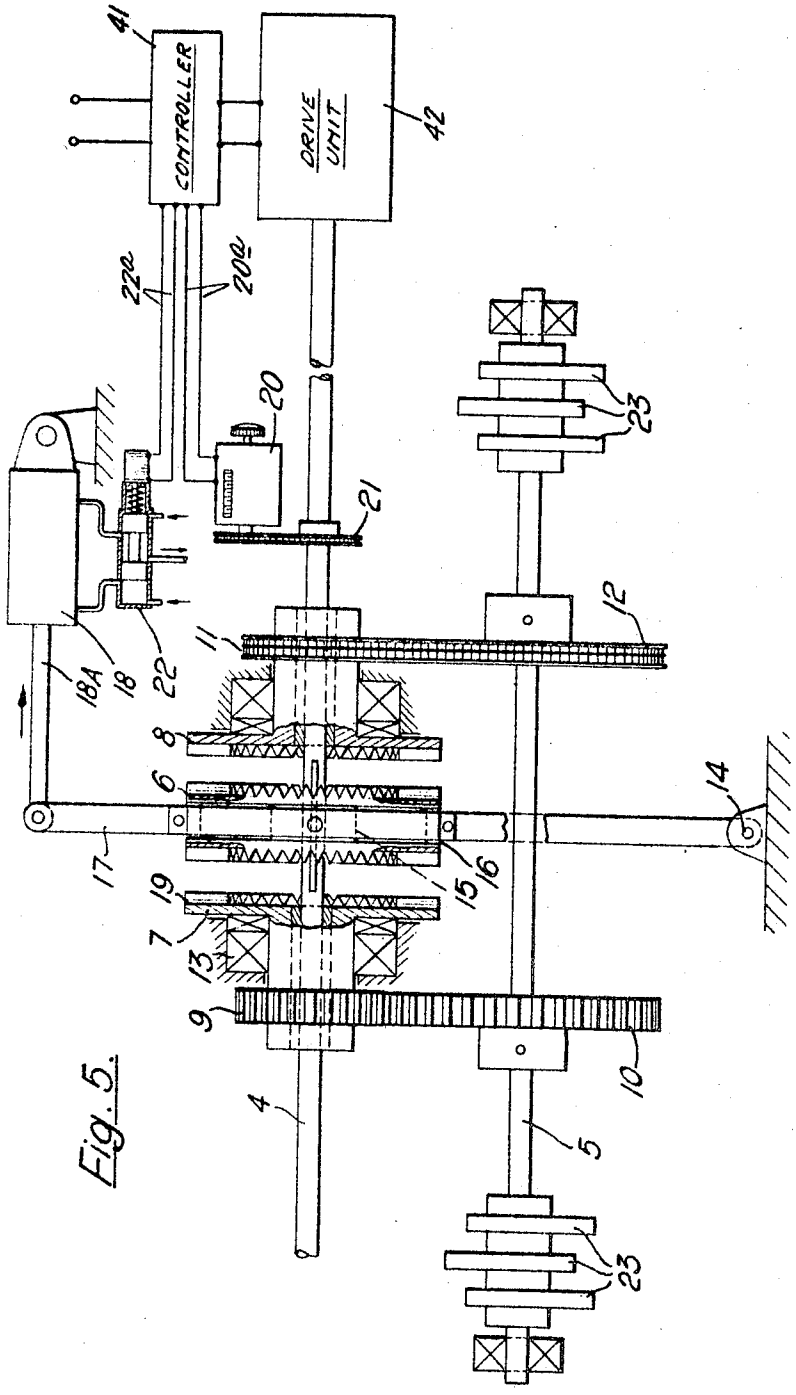

Fig. 5.

Inventor:
IAN GEORGE CUMMING
By Howson & Howson
Attorneys

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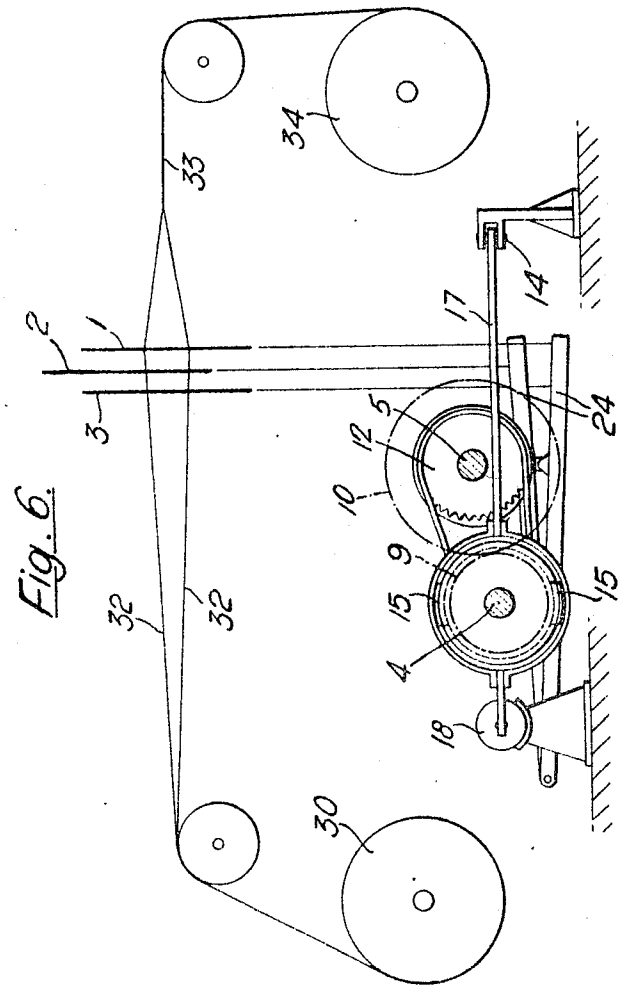

Fig. 6.

Inventor
IAN GEORGE CUMMING
By Howson & Howson
Attorneys

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ENDLESS BELT FOR PAPER OR BOARD MAKING MACHINE AND A METHOD OF WEAVING CLOTH THEREFOR

Ian George Cumming, Granton, Edinburgh, Scotland, assignor to The United Wire Works Limited, Granton, Edinburgh, Great Britain, a British company

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Int. Cl. D03d *15/02;* D03c *5/00;* B21f *27/02*
U.S. Cl. 139—425 8 Claims

ABSTRACT OF THE DISCLOSURE

Woven cloth for an endless belt for a paper or board making machine is a twill woven cloth and the twill pattern is reversed at intervals of from two inches to four feet. Each warp of the cloth then forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

A loom for weaving the cloth is provided with means for reversing the operation of the heddle frames of the loom at the required intervals so as to reverse the twill pattern.

This invention relates to woven cloth for endless belts for paper or board making machines, and to a method of making such cloth.

Such belts are used on the wet end of Fourdrinier paper or board making machines to convey and dewater paper pulp so as to form a mat or sheet of fibres. The cloth may be woven with metal or synthetic warps and wefts, or with metal warps and synthetic wefts, or with synthetic warps and metal wefts, the belt being formed by joining together the ends of the cloth with the warps running lengthwise of the belt.

Due to the woven construction, the warps form knuckles on the underside and topside of the woven belt, and, in operation, the underside warp knuckles are subjected to severe abrasive wear as the belt travels over suction boxes and other stationary surfaces such as forming boards and foils which are fitted to the paper or board making machine. Furthermore, on Inverform Machines, very severe abrasive wear is caused by the autoslice blades.

Under certain conditions, the warp knuckles wear grooves in the surface of the tops of the suction boxes and on the leading edges of the autoslice blade, and these grooves are a replica of the longitudinal pattern of the underside warp knuckles.

A grooved suction box top may result in a very serious shortening of the life of the belt and create faults in the paper or board being made.

In operation, there is a tendency for the belt to move to one side or the other of the paper or board making machine under the action of guide rolls. When a suction box top is grooved, the belt "hangs" on the box and resists the normal lateral movement of the belt. Increasing lateral force is built up by automatic guide rolls causing severe lateral thrust on the warp knuckles in the grooves and severe wear on the sides of the knuckles. If the belt is released from the grooves due either to sufficient lateral pressure or to the presence of a discontinuity in the pattern of the underside warp knuckles, as for example at the joint or seam which makes the belt endless, the belt slides over the top of the grooves which rasp the warp knuckles, causing further wear and frequently a disturbance in the uniformity of the sheet formation.

A grooved suction box top also causes serious trouble

when a new belt is fitted. Differences in warp pattern in relation to the grooves cause severe local wear and drastically reduces the life of the belt.

This problem in the operation of paper machine belts has been known for many years by paper and board machine belt manufacturers, paper and board machine builders and paper and board makers, and while various methods of overcoming the difficulty have been proposed and practised, and some success has been achieved, these methods have not been entirely successful or have involved additional handling of the cloth after weaving and a further stage in the process of finishing the cloth or forming the belt.

An object of the present invention is to provide cloth, which, when formed into a belt and used on a paper making machine as aforesaid, does not form grooves in the tops of the suction boxes and does not react undesirably to grooves previously formed thereon, or which has a lesser tendency to do so than belts hitherto used.

According to the present invention we provide twill woven cloth for forming or formed into an endless belt for a paper or board making machine in which the twill pattern is reversed at predetermined intervals so that each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

Further, according to the present invention we provide a method of weaving twill cloth for an endless belt for a paper or board making machine comprising reversing the twill pattern at predetermined intervals so that each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

Still further, according to the present invention we provide a loom for weaving twill cloth for endless belts for paper or board making machines in which there is provided apparatus adapted and arranged so as to reverse the operation of the heddle frames at predetermined intervals.

Said apparatus may comprise forward and reverse drives from the main shaft of the loom to the heddle cam shaft, a clutch for effecting engagement of one or other of said drives, a clutch-actuating device, and a time switch device controlling the latter so that the said drives engage alternately at predetermined intervals.

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawings, in which:

FIG. 1 shows schematically a plan view of a typical conventionally woven three shed twill paper or board making belt, in which the twill pattern A_1—A_1 is going from right to left when viewed in the direction of the arrow,

FIG. 2 is a fragmentary view corresponding to FIG. 1, to a larger scale, the twill pattern A_2—A_2 going from right to left when viewed in the direction of the arrow,

FIG. 3 shows the top surface of a typical conventionally woven three shed twill, in which the twill pattern A_3—A_3 is going from left to right when viewed in the direction of the arrow,

FIG. 4 shows the top surfaces of a panel of cloth in accordance with the present invention, in which the twill patterns A_4—A_4, A_5—A_5 and A_6—A_6 are reversed from left to right to right to left and then to left to right when viewed in the direction of the arrow,

FIG. 5 shows a diagrammatic view of apparatus for effecting the change in sequence of heddle reciprocation in a loom so as to reverse the twill pattern, and

FIG. 6 shows a diagrammatic side view of the cams and heddle arrangements in a loom.

In FIG. 1 the warps run parallel to the running axis

27 of the wet end of a paper or board making machine. The seam 28 is constructed in the usual welded, soldered or sewn manner and runs at an angle to the transverse axis 29 of the belt, the axis 29 being at right angles to the axis 27. In a typical twill weave each warp is interlaced with the weft so that it passes over one weft and under the next two. Adjacent warps follow the same pattern of interlacing but are arranged to be out of phase with each other by one weft. In such a twill woven cloth, the topside knuckles of a series of adjacent warps created by passing over wefts follow diagonal lines A_1—A_1 across the width of the cloth.

The details of weave shown in FIG. 1 is shown in FIG. 2, and the pattern can be changed to form a line of knuckles running in a diagonally opposite direction A_3—A_3 across the cloth by changing the pattern of interlacing as shown in FIG. 3.

It has now been found that, if the twill pattern is changed at regular intervals, the warps follow a chevron or zig-zig pattern, as shown in FIG. 4. The angle of slope is influenced by the flexibility of the warp and weft, the diameter of the warp and weft and the numbers of warps and wefts per inch. In FIGS. 2, 3, and 4, the warps are indicated by the numeral 25, and the wefts by the numeral 26.

In its simplest form, weaving consists of taking every alternate warp and holding it apart from the intervening warps so that the weft may thus be placed. The alternate warps are then crossed over the weft which has just been placed and another weft is placed. The process repeats and a plain woven cloth results. In this example, the two groups into which the warps are divided are known as sheds. To form twill, it is necessary to divide the warps into a minimum of three sheds. The sheds are created by threading each warp through a heddle and the heddles corresponding to the warps of one shed are held in one frame whilst the heddles corresponding to the warps of the other sheds are held in other frames. The number of frames is determined by the number of sheds required. In a three shed twill, for example, it is necessary to have three heddle frames as shown in FIG. 6 at 1, 2 and 3. In order that the warps and wefts may be interlaced it is necessary for the heddle frames 1, 2, 3 to reciprocate vertically. This is arranged by a system of levers known as treadles and shown in FIG. 6 at 24 which are articulated by a bank of cams 23, FIG. 5. There are two treadles 24 to each heddle frame and one cam 23 to each treadle 24. In a three shed twill in which the warps pass over one weft and under two, the cycle for each heddle frame is such that the frame is held down whilst two wefts are placed and is held up whilst a third weft is placed. The sequence of operation is such that for the first weft the first frame is up whilst the second and third frames are down. The second frame comes up for the second weft and the first and third remain down. The first cycle is complete after the next move when the third frame comes up for the third weft and the first and second stay down. This sequence of operation creates a slope in the warps, as already described, in one direction. A slope in a diagonally opposite direction is obtained by precisely reversing the sequence so that, after the first frame has been up, the third frame comes up whilst the first and second stay down. Next, the second frame comes up whilst the first and third stay down. In FIG. 6, 30 indicates the warp beam, 32 indicate warps in a shed, 33 indicates the woven cloth, and 34 the cloth beam.

This reversal action is achieved in a loom as follows:

The mainshaft 4 is a constantly rotating shaft, running at half the loom speed, and the heddle cam shaft 5 is driven from the mainshaft 4 through two spur gear wheels 9, 10 or a chain and chain wheels 11, 12. The ratios of the spur gears and chain wheels are identical and in this embodiment each ratio is 1.5/1.

The spur gear 9 and chain wheel 11 are both free to rotate on the mainshaft 4 but are held in a fixed position along the mainshaft 4 by split thrust and journal bearings 13. The gear wheel 10 and the chain wheel 12 are both fixed to the heddle cam shaft 5, and the latter drives the heddle cams 23 which in turn actuate the heddle frames 1, 2 and 3 carrying the warps.

Between the wheels 9 and 11 on the mainshaft 4 there is a clutch member 6 which rotates with and is movable along the mainshaft 4 on a sliding key. When the clutch 6 is moved from left to right in FIG. 5 it engages a clutch member 8 and disengages a clutch member 7. The members 7 and 8 are fixed to the gear wheel 9 and chain wheel 11 respectively. As can be seen, if clutch member 6 is moved from engagement with the member 7 into engagement with the member 8, the shaft 5 changes direction of rotation.

The clutch member 6 is moved along shaft 4 by means of a rod 18A of a piston in an air cylinder 18 pushing or pulling a lever 17 which is pivotally mounted at 14. Clutch shoes 15 are pivotally attached to the lever 17 and fit into an annular recess 16 in the clutch member 6. The internal faces of the clutch members 7 and 8 have teeth 19 which engage with similar teeth on the external faces of the member 6.

A sequence-timing device 20 is provided for counting a predetermined number of wefts inserted and is actuated by a drive 21 fixed to the shaft 4. When the device 20 reaches a pre-set number, the device 20 through connections 20*a* actuates a controller 41 which is connected to the drive unit 42 for the main shaft 4 and is also connected through connections 22*a* to a solenoid-controlled valve 22 for the air cylinder 18. When the device 20 triggers the controller 41, it operates through the drive unit 42 to arrest the drive to the shaft 4 to stop the loom, and then after a timed delay of two to three seconds, the controller 41 energizes the solenoid-controlled valve 22, for example, as shown in FIG. 5, to retract the rod 18A and move the lever 17 from left to right, thus first disengaging the gear drive 9, 10 and thereafter engaging the chain wheel drive 11, 12. The loom is then restarted automatically to continue weaving with a reversed twill pattern. When the next pre-set number is reached, the device 20 again actuates the controller 41 which thereagain stops the loom and after a timed delay of two to three seconds de-energizes the solenoid valve 22 to thereby extend the rod 18A to shift the lever 17 from right to left, first disengaging the chain wheel drive 11, 12 and then engaging the gear drive 9, 10. The loom is then restarted automatically with the result that the twill pattern weave is again reversed and returns to the original direction. The device 20 then counts a predetermined number of wefts and the operation is repeated so that the direction of the twill pattern is reversed in alternation throughout the length of the cloth.

As an example of the effect of reversing the pattern of a three shed twill, a typical cloth containing 60 warps of 0.0096 inch dia. to the inch and 45 wefts of 0.0108 inch dia. to the inch develops a slope of one-sixth of an inch in 9 inches of cloth if the twill pattern is reversed at 9 inch intervals. Expressing this another way the angle subtended at the apex of each chevron is 178° C.

The foregoing example is not to be held to imply that the invention is limited to a particular twill specification, nor to a particular distance between reversals of the twill pattern. According to the conditions encountered on a paper or board making machine, the distance between reversals may be varied from 2 inches to 4 feet with advantage and the twill specification may be selected from the full range of twills which it is possible to weave.

The invention uses in a controlled manner the phenomenon that the warps and wefts of cloth woven in a twill pattern in a normal state of equilibrium do not lie at right angles to each other. The following is an example of this phenomenon. When a length of twill cloth woven with the same pattern throughout its length is laid out

flat it forms a parallelogram. If such a piece of twill woven cloth is formed into an endless belt the line of the joint forms an angle with the transverse axis of the belt. When such a belt is used on a paper or board machine, the warp lies parallel to the running axis of the wet end of the paper or board making machine and the weft lies parallel to the seam or joint.

Thus, if a length of twill woven cloth is woven in a series of sections in which the twill pattern is reversed in each section by reversing the sequence of operation of the heddles of the loom, the wefts at the point of reversal lie parallel to the transverse axis and the warps change direction so as to lie at alternate opposite angles to the runing axis. By joining the ends of such cloth, an endless belt is formed, in which each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

The cloth may be, for example from 40 to 110 mesh.

I claim:

1. In an endless belt for a paper making machine made of twill woven cloth, said belt having warps extending throughout the length of the belt and wefts extending across the width of the belt, the improvement consisting in that the cloth comprises a series of sections throughout the length of the belt and the twill pattern is reversed between successive sections, whereby each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

2. An endless belt as claimed in claim 1, in which the twill pattern is reversed at from two inch to four foot intervals, and the cloth is from 40 to 110 mesh.

3. An endless belt as claimed in claim 1, in which the twill pattern is reversed at 9" intervals, and the angle subtended at the apex of each chevron is 178°.

4. In a method of weaving twill cloth and forming therefrom an endless belt for a paper making machine, said belt having warps extending throughout the length of the belt and wefts extending across the width of the belt, the steps of weaving the cloth in a series of sections throughout the length of the belt, and reversing the twill pattern between successive sections whereby each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

5. The method claimed in claim 4, in which the reversal of the twill pattern is effected by reversing at predetermined intervals the operation of the heddle frames of the loom on which the cloth is being woven.

6. The method claimed in claim 4, in which the twill pattern is reversed at from two inch to four foot intervals and the cloth is 40 to 110 mesh.

7. The method claimed in claim 4, in which the twill pattern is reversed at 9" intervals, and the angle subtended at the apex of each chevron is 178°.

8. Twill woven Fourdrinier cloth having a series of sections throughout its length, warps extending through said series of sections, and wefts extending across the width of the cloth, in which the twill pattern is reversed between successive sections, whereby each warp forms throughout its length a series of substantially chevron-shaped formations transversely directed in the plane of the cloth.

References Cited

UNITED STATES PATENTS

1,587,338	6/1926	Lindsay	139—425.5
2,143,552	1/1939	Green	139—425.5
2,152,982	4/1939	Watson et al.	139—80
2,227,669	1/1941	Parrett	139—425.5
2,903,021	9/1959	Holden et al.	139—425.5
3,139,119	6/1964	Buchanan	139—425.5
3,211,606	10/1965	Watson	139—425.5
3,214,818	11/1965	Ewen.	

FOREIGN PATENTS

1,296,090	5/1962	France.
427,915	5/1935	Great Britain.

OTHER REFERENCES

The Cambridge Wire Cloth Company, pp. 1 and 14, rec'd U.S. Patent Office Feb. 19, 1932.

JAMES KEE CHI, Primary Examiner

U.S. Cl. X.R.

139—80; 245—8