Dec. 22, 1959 H. S. FREYNIK 2,918,094

FOURDRINIER WIRE BELT, WIRE, AND ALLOY COMPOSITION THEREOF

Filed April 12, 1957

FIG. 1.

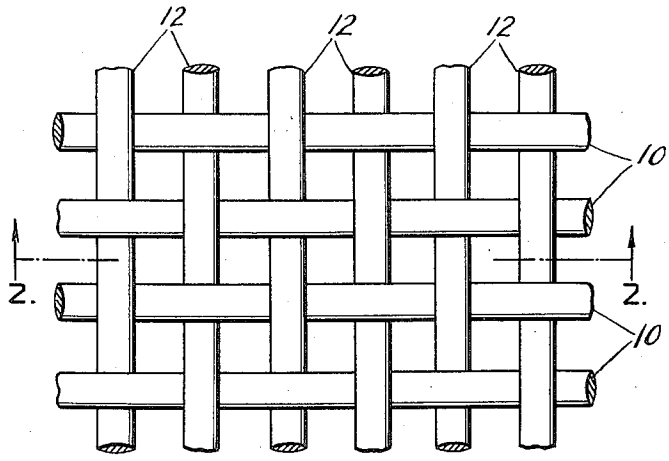


FIG. 2.

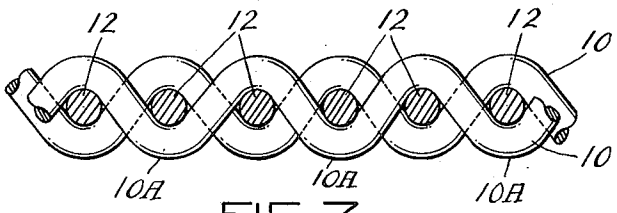


FIG. 3.

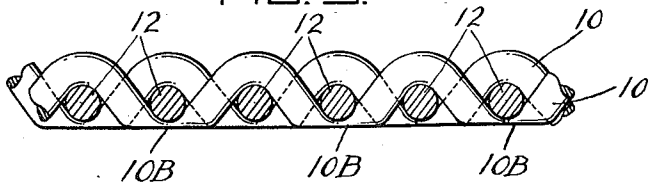
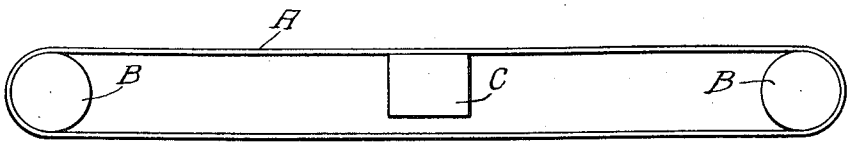


FIG. 4.



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FOURDRINIER WIRE BELT, WIRE, AND ALLOY COMPOSITION THEREOF

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18 Claims. (Cl. 139—425)

This invention relates to Phosphor bronze alloys, and more particularly to manganese-containing Phosphor bronze alloys characterized by high resistance to abrasive wear.

This invention also relates to wire characterized by high resistance to abrasive wear formed of novel manganese-containing phosphor alloys, which wire is particularly adaptable for forming the warp wires of woven wire belts of the character used on paper-making machines of the Fourdrinier type.

This invention further contemplates a woven wire belt of high resistance to abrasive wear, particularly adaptable for use in Fourdrinier machines.

Wear on Fourdrinier wire belts is generally considered to result mainly from their frictional contact with parts of the paper-making machine. For example, because the belts are woven, relatively sharp bends or warp knuckles are formed in the warp wires where they cross the shute wires. These warp knuckles are subjected to abrasive wear by friction contact with portions of the paper-making machine, such as suction box covers and rollers. The presence of particulate abrasive materials in the paper mixture, some of which are introduced in preparation of the pulp, results in additional abrasive wear. Thus, the warp wires, particularly at the warp knuckles, in time become worn thin.

Phosphor bronze alloys, as for example an alloy comprising about 92% copper, 8% tin, and 0.35% phosphorus, for many years have been considered the best material for warp wires for woven wire belts for paper-making machines of the Fourdrinier type. Although such Phosphor bronze alloys proved to be a very satisfactory material for such purpose in paper-making machines operating at moderate speeds, operating speeds of paper-making machines have been substantially increased in recent years and warp wires of such Phosphor bronze alloys wear out relatively rapidly on high speed machines due to increased abrasive wear necessitating undesirable discontinuance of paper-making operations to replace a worn belt during the working days of the week, rather than during ordinary shut-down periods, as for example on week-ends. Thus, for 20 or more years, many efforts have been made to find a warp wire alloy composition for high speed paper-making machines, which alloy possesses the desirable properties of such Phosphor bronze alloys, such as good flexibility, corrosion resistance, and the like, and in addition possesses substantially increased resistance to abrasive wear.

With these considerations in mind, reference is made to the drawing, in which drawing:

Fig. 1 is an enlarged, fragmentary, detail plan view of a part of a woven wire belt of a Fourdrinier machine;

Fig. 2 is a detailed, sectional view taken substantially along the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a sectional view similar to that of Fig. 2, of the same belt after a period of use on a Fourdrinier machine; and

Fig. 4 is a diagrammatic view of a testing machine which simulates conditions present in a Fourdrinier machine, which machine comprises a wire fabric joined into an endless belt mounted on rollers and intermediately passing across a block of wood, representing the suction box of a Fourdrinier machine.

Referring now to the drawing, in Figs. 1–3, the wire belt of a Fourdrinier machine comprises warp wires **10** and shute wires **12** assembled in plain weave. From Fig. 2 it can be seen that the undulations of warp wires **10** result in knuckles **10***a* where they cross shute wires **12**. The wire fabric illustrated in Fig. 2 is a newly woven fabric and the warp wires, of course, do not evidence any wear. In Fig. 3 is illustrated the same wire belt as illustrated in Figs. 1 and 2, after the belt has been employed on a Fourdrinier machine. This figure illustrates that the knuckles **10***b* have been worn relatively flat due to abrasive wear as the belt passes over one or more suction boxes and rollers. The shute wires, since they do not come in contact with parts of the paper-making machine, are not subjected to similar abrasive wear. Since breaking of the belt entails tremendous expense, the thickness of the warp wires at the knuckles formed by intersection with the shute wires is continually checked. When paper-making machines are operated at moderate speeds, the belt is generally removed and replaced when the wear of these knuckles is on the order of about 80%; however, when relatively high speeds are employed, there is substantially greater tension on the warp wires, which necessitates removal of the belt at a time considerably before this degree of wear takes place.

A primary object of this invention is the provision of a novel manganese-containing Phosphor bronze alloy characterized by high resistance to abrasive wear.

Another primary object of this invention is to provide a wire characterized by high resistance to abrasive wear formed of a novel manganese-containing Phosphor bronze alloy.

A further object of this invention is the provision of a novel Phosphor bronze wire characterized by resistance to abrasive wear particularly adaptable for forming the warp wires of woven wire belts of the character used on paper-making machines of the Fourdrinier type.

Another object of this invention is a woven wire belt of high resistance to abrasive wear particularly adaptable for use in high speed Fourdrinier machines.

These and other objects will become further apparent from a consideration of this specification and claims.

According to this invention there is provided a novel manganese-containing Phosphor bronze alloy characterized by substantial flexibility, corrosion resistance, and high resistance to abrasive wear comprising from about .5% to 10% manganese, about 3% to 11% tin, about .05% to .5% phosphorus and balance copper.

There is also provided by this invention a flexible, corrosion-resistant wire characterized by high resistance to abrasive wear formed of an alloy comprising from about .5% to 10% manganese, about 3% to 11% tin, about .05% to .5% phosphorus and balance copper.

There is further provided according to this invention a woven wire belt particularly adaptable for use in high speed Fourdrinier machines, having warp wires characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear formed of an alloy of the composition set forth above.

It has been found that wire which is highly resistant to abrasive wear can be provided by means of a novel Phosphor bronze alloy containing a small amount of manganese. Abrasion tests have indicated that wire formed of such an alloy has a life span on an average of about 2½ times longer than wire formed of known Phosphor bronze alloys. This means that by employing

a woven wire belt having warp wires of the novel alloy of this invention the frequency of shut-down of a Fourdrinier machine operating at high or moderate speeds in order to replace a worn belt will be greatly decreased. This is of particular value in the operation of high speed machines where the frequency of shut-down is relatively high and the degree of wear of a belt often requires discontinuing paper-making operation to replace a belt during the working days of the week, rather than during ordinary shut-down periods, as for example on weekends. Such shut-down periods, particularly during the work week, are costly in that they are unproductive; therefore, by means of this invention the rate of output of paper by a particular paper-making machine can be substantially increased and shut-down periods during the working days of the week may be held to a minimum. Obviously, considerable economic advantages are to be gained from this invention.

As stated above, the novel alloy of this invention from which the wire, which is particularly adaptable for forming the warp wires of wire belts of the character used in paper making machines of the Fourdrinier type, comprises from about .5% to 10% manganese, about 3% to 11% tin, about .05% to 5% phosphorus and balance copper. Wire formed of such alloy possesses all of the advantageous properties of prior Phosphor bronze wire, as for example good flexibility, good corrosion resistance, and the like, and in addition possesses exceptionally high resistance to abrasive wear. Preferably, the highly abrasive resistant alloy or this invention comprises from about 1% to 5% manganese, about 6% to 8% tin, about .2% to .4% phosphorus and balance copper. A highly abrasive resistant alloy composition, which is particularly suitable for forming wire of the type particularly adaptable for forming the warp wires of woven wire belts for paper making machines, comprises approximately 1.5% manganese, 7.5% tin, .3% phosphorus, and balance copper.

In employing wire of the above-described novel alloy compositions as the warp wires woven wire belts of paper making machines, the wire generally will have a diameter no greater than about .08 inch. In most wire belts of Fourdrinier machines, the warp wires will generally have a diameter of from about .0035 to about .017 inch. The wire may be woven into a belt, as for example of plain weave of the type illustrated in Fig. 1, twill weave, or other weave generally employed in such belts, the wire forming the warp wires, such as warp wires **10** of Figs. 1–3. Of course, an entire web can be formed of wire of the novel alloy composition of this invention. Generally however, brass shute wires are employed since they are not subjected to abrasive wear in the same manner as the warp wires.

The resistance to abrasion of the manganese-containing Phosphor bronze alloy of this invention was compared with the resistance to abrasion of ordinary, well known Phosphor bronze alloy in the following manner. A number of wires 0.10 in. in diameter were drawn from larger wire by means of diamond dies and were annealed to a tensile strength of about 75,000 p.s.i. The alloy composition of some of the wires, used for comparison purposes, comprised 7.5% tin, 0.35% phosphorus and the balance copper. The alloy composition of other wires also included a small amount of manganese which replaced a portion of the copper, the phosphorus and tin content of these alloys being the same as in the alloy of the comparison wires. Wires tested contained 1, 2 and 4%, respectively, of manganese.

One end of each of the wires tested was securely fastened to prevent movement, the wire was wrapped about a 4 inch diameter corrosion-resistant chromium-steel drum. A one ounce weight was attached to the other end of the wire. The lower portion of the drum was immersed in an aqueous solution containing one ounce of diatomaceous earth per gallon of solution. The drum, which was power driven, was rotated at 100 r.p.m. At timed intervals, the rotation of the drum was stopped, and the thickness of the wire was measured, and rate of wear of wire having the alloy composition of this invention was compared with that of the standard Phosphor bronze alloy wire.

Several wire screens, certain of which had warp wires of an alloy composition of this invention, i.e. containing manganese in the amount of 1, 2 and 4%, respectively, and wire screen having warp wires of standard Phosphor bronze alloy were prepared and formed into endless belts by silver brasing. The shute wires of all screens tested were formed of brass containing 83% copper and 17% zinc. The belts were tested on a testing machine similar to that illustrated in Fig. 4. The endless belt A was placed about two drums B, one of which was driven by an electric motor and the other of which was driven through the wire belt. The lower portion of the belt and drums were immersed in a pulp solution containing 1.25 ounces of diatomaceous earth per gallon. Midway between the two drums a block of maple wood C, end grained, was placed against the wire belt to simulate a suction box. The maple block collects any abrasive substance and wears against the wire and closely duplicates Fourdrinier machine conditions of wear. The drums were rotated at 1000 r.p.m. At regular timed intervals, the machine was stopped and the thickness of each screen was measured. The rate of wear of the belts having warp wires of the alloy of this invention was compared with those having warp wires of standard Phosphor bronze alloy.

These several tests indicated that warp wires of the alloy composition of this invention, containing manganese, have substantially greater resistance to abrasive wear than do warp wires of standard Phosphor bronze alloy. For example, these tests indicated that the wire of the alloy composition of this invention will outwear wire of standard Phosphor bronze composition by from 200 to 300%. This means, that wire belts for Fourdrinier machines having warp wires formed of the novel manganese-containing Phosphor bronze alloy of this invention last from two to three times as long as wire belts having warp wires of standard Phosphor bronze composition.

I claim:

1. A manganese-containing phosphor bronze alloy characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear consisting essentially of from 1% to 5% manganese, 6% to 11% tin, .2% to .4% phosphorus and balance copper.

2. The alloy composition of claim 1 consisting essentially of 1.5% manganese, 7.5% tin, .3% phosphorus, and balance copper.

3. The alloy composition of claim 1 containing 6% to 8% of tin.

4. Wire characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear formed of an alloy consisting essentially of from 1% to 5% manganese, 6% to 11% tin, .2% to .4% phosphorus, and balance copper.

5. Wire of claim 4 having a diameter not greater than about .08 inch.

6. Wire of claim 4 having a diameter of from about .0035 to about .017 inch.

7. Wire of claim 4 containing 6% to 8% of tin.

8. Wire characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear, particularly adaptable for forming the warp wires of woven wire belts of the character used on paper making machines of the Fourdrinier type, formed of an alloy consisting essentially of 1.5% manganese, 7.5% tin, .3% phosphorus, and balance copper.

9. Wire of claim 8 having a diameter not greater than about .08 inch.

10. Wire of claim 8 having a diameter of from about .0035 to about .017 inch.

11. A woven wire belt particularly adaptable for use in Fourdrinier machines having warp wires characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear formed of an alloy consisting essentially of from about 1% to 5% manganese, 6% to 11% tin, .2% to .4% phosphorus, and balance copper.

12. The woven wire belt of claim 11 in which the warp wires have a diameter not greater than about .08 inch.

13. The woven wire belt of claim 11 in which the warp wires have a diameter of from about .0035 to about .017 inch.

14. The woven wire belt of claim 11 in which the alloy forming the warp wires contains from 6% to 8% tin.

15. A woven wire belt particularly adaptable for use in Fourdrinier machines having warp wires characterized by substantial flexibility, corrosion resistance and high resistance to abrasive wear formed of an alloy consisting essentially of 1.5% manganese, 7.5% tin, .3% phosphorus, and balance copper.

16. The woven wire belt of claim 15 in which the Phosphor bronze warp wires have a diameter not greater than about .08 inch.

17. The woven wire belt of claim 15 in which the Phosphor bronze warp wires have a diameter of from about .0035 to about .017 inch.

18. The woven wire belt of claim 17 having brass weft wires.

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