ABSTRACT OF THE DISCLOSURE

A doffer comb mechanism is provided utilizing a rotary shaft and an oscillatory shaft, with a comb blade attached to the oscillatory shaft at a fixed distance therefrom. The oscillatory shaft is driven from both ends of the rotary shaft, and the comb blade is carried by arms extending from the oscillatory shaft, the arms being disposed at node points of the fundamental resonance of the comb blade, to eliminate unwanted vibrations. Other means comprising wires facilitate proper positioning of the blade from the oscillatory shaft are provided along its length.

The following specification relates to a novel improvement in doffer comb mechanism adapted for removing stock from the doffer cylinder of a carding machine. In present practice, the output efficiency of a carding machine for cotton and similar fibers depends upon the speed at which the doffer comb can be oscillated. The maximum speed at which the current doffer comb oscillating mechanism operates, is approximately 1800 cycles per minute. This constitutes an economic limitation on fiber processing.

It is therefore an object of this invention to provide a new and improved doffer comb mechanism capable of operating successfully at higher speed in excess of 1800 cycles per minute. A further object of the invention is to avoid excessive wear on the supporting bearings or eccentric mechanism at the increased speed.

Among the objects of the invention is to insure an even stroke of the comb.

A further object of the invention is to effect successful operation of the machine without developing disturbing resonance.

A still further object of the invention is to control the horizontal deflection of the comb toward and from the doffing cylinder.

As illustrating this invention, the preferred form thereof has been shown by way of example on the accompanying drawings in which:

FIGURE 1 is the side elevation of the output end of a carding machine with which the novel combination is associated;

FIGURE 2 is a plan view of the same;

FIGURE 3 is a side elevation of the same;

FIGURE 4 is a front elevation partly in section of the right end of the mounting on the line 4—4 on FIGURE 3;

FIGURE 5 is a partial plan view, parts broken away, of the right end as shown in FIGURE 3;

FIGURE 6 is a partial front elevation of the left end thereof;

FIGURE 7 is a partial plan view partly in horizontal section on the line 7—7 in FIGURE 6;

FIGURE 8 is a side view of a flange of the tubular portion of the oscillating shaft;

FIGURE 9 is a vertical section of the outer connecting bracket for the end support of the oscillating shaft;

FIGURE 10 is a side elevation of the same;

FIGURE 11 is a plan view of the left-hand end support for the oscillating shaft;

FIGURE 12 is a vertical section on the line 12—12 on FIGURE 5;

FIGURE 13 is a vertical section on the line 13—13 on FIGURE 5;

FIGURE 14 is a fragmentary elevation of the doffer comb as seen from line 14—14 on FIGURE 5;

FIGURE 15 is a transverse vertical section on the line 15—15 of FIGURE 7;

FIGURE 16 is a perspective view of a reinforcing bracket shown in FIGURE 15;

FIGURE 17 is a transverse cross-section on the line 17—17 of FIGURE 13, and

FIGURE 18 is a plan view of one of the separate end support shafts of the rotary drive shaft.

In brief, the invention includes, among other features which will be discussed later, a dual drive unit for oscillating the doffer comb oscillating shaft. This dual drive unit comprises an eccentric mechanism on either side of the oscillating shaft. Both eccentric mechanisms are connected with each other by a rotary drive shaft which extends above and parallel to the oscillating shaft. Like the oscillating shaft, the rotary drive shaft is supported by two upright structures and is driven by a belt which is trained over a ratio multiplier pulley mounted on a third shaft disposed in the base portion of one of the upright structures. The oscillating shaft supports a lightweight comb blade by means of two supporting arms. A plurality of steel wires are strung from the comb blade to the oscillating shaft, each individual wire passing through a spacer tubing interposed between the comb and the oscillating shaft.

In developing this new unit it has been found that, when operating a doffer oscillating mechanism at high speeds, say above 1800 r.p.m., a number of problems arise, some of which are (a) the torsional stress in the oscillating and drive shafts, (b) the deflection imposed upon the oscillating shaft by the inertia forces of its own mass and the mass of the comb blade, (c) the deflection of the comb blade in relation to the doffer cylinder, (d) the resonant vibration in the oscillating shaft, the drive shaft and the comb blade, and (e) the total effect of all these factors upon the driving mechanism and the stroke of the comb. The problems arising through torsion are some of the factors that cut down the effectiveness of conventional doffer comb mechanisms. This becomes apparent especially with respect to the speed and performance of the comb. These torsion problems are mainly caused by the fact that in conventional doffer mechanisms the drive is imparted to the oscillatory shaft from just one side. Torsional stress will cause the oscillatory shaft to twist and its bearings to wear out more rapidly. Consequently, the comb will no longer assume parallelism with the oscillatory shaft during operation so that the stroke becomes uneven, resulting in a lesser quality of the sliver. We have obviated this by supplying an identical driving force at both ends of the oscillatory shaft. For this purpose, we have provided dual drive means interconnected by a drive shaft extending in parallelism with the oscillatory shaft.

A further step toward this end was to decrease the load imposed upon the oscillatory shaft and its bearings by reducing the weight of the comb blade and the supporting arms as much as possible. We also mounted counterweights on the ends of the drive shaft for balancing the reciprocating motion of the connecting rods driving the oscillatory shaft.

In order to prevent damages caused by excessive vibration, especially by resonant vibration, efforts were made
to raise the resonant frequency of the important components involved so far that resonance could not be attained during operation of the mechanism. As a rule, the resonant frequency is proportional to the square root of the ratio of the stiffness of the system to its mass. In accordance with this rule, we raised the resonant frequency of the drive and the oscillating shaft to 8000 cycles per minute by giving them a relatively high stiffness in comparison to their weight. This was accomplished by constructing each shaft with a central tubular portion.

On the other hand, there was the problem of raising the resonant frequency of the comb blade high enough so that it could not be excited during the operation of the doffer comb mechanism. This goal was achieved by changing the mode or shape in which the comb can vibrate. It is known in the art that the resonant frequency of a supported bar depends on the mode or shape which it assumes when vibrating. The determining factor for this mode, however, is mostly the manner of its support.

If a bar is supported at its ends and is deflected in the middle (mode) while vibrating, it will resonate at a certain frequency. If the same bar is supported at a certain distance away from its ends and its middle and ends are deflected in opposite directions while vibrating, it will resonate at an even higher frequency. If, finally, said bar is so supported that its ends and middle will be deflected in the same direction while vibrating, then the resonant frequency is still higher than in the foregoing case. We have found we obtain such a mode of vibration as stated in the latter case by supporting the comb blade at the node points of its fundamental resonance. The so obtained resonant frequency of the comb blade is so high that the danger of exciting resonance in the blade is virtually eliminated.

Summarizing the facts outlined above we may say that the resonant frequency of the doffer comb blade is so high that we could not drive our mechanism fast enough to excite any. Also, we may say that the resonant frequency of the drive shaft and the oscillating comb shaft is approximately 8000 r.p.m. In the latter case, this means that if we had to deal with a pure harmonic in the driving motion, we could run our mechanism at a top speed of somewhat less than 8000 r.p.m., as in this case only the former r.p.m. amount to 6000 r.p.m. would cause our mechanism to resonate. However, due to the use of connecting rods, there is a second harmonic in the motion which constitutes a force component that could excite resonance in the above-mentioned shafts at 4000 r.p.m. Consequently, this limits our driving speed to somewhat less than 5000 r.p.m.

The vertical deflection, since it is very minute, offers no problem when the blade is oscillated below the resonant frequency. However, the horizontal deflection of the blade in the direction of the cylinder is quite another problem and one which must be stringently controlled.

In order to obtain such control, a number of steel wires are strung through spacers from the comb blade to the oscillating shaft. These spacers serve to keep the blade straight when proper tension is applied to each wire. It is important that these wires do not function as additional comb supports and thereby upset the mounting of the comb. Therefore, the wires are at one end pivoted secured to the oscillating shaft and at the other end secured to the comb blade. Thus the wire spacer sleeve arrangements may follow every vertical deflection of the comb blade without causing any resistance there-against.

This is of utmost importance, as such resistance could cause a change in the mode of the vibrating curve.

In the form illustrated in the drawings, the output end of the carding machine is shown with the improved doffer comb mechanism 21 arranged adjacent the doffer cylinder 22, which has a shaft 23 rotatably mounted in bearings 24, which in turn rest upon the bed 25.

The doffer cylinder has cards 26 armed with teeth 27, which card the cotton or other fiber material so that the filaments are oriented in a parallel web. The oscillating doffer comb, denoted generally by 28, strips the web material for further operation.

The doffer comb 28 is caused to oscillate principally in a vertical plane to and from the surface of the cards 26. This oscillation is provided by a synchronized dual drive. Two upright frame structures 29 are mounted at opposite ends of the bed 25 of the carding machine.

Affixed to the lower portion of one of said frame structures, dependent on the location of the source of power, is a cast iron housing 30. An overdrive shaft 31 is supported by bearings 32 and 33. This shaft has an outer pulley 34.

A belt 35 is trained over pulley 34 and pulley 36 on a drive or power shaft 37. Shaft 37 also drives the shaft 23 of the doffer cylinder.

Referring to FIGURES 4 and 5, a second pulley 38 is connected by means of a belt 39 to one of two pulleys 40, 41, mounted upon opposite ends of a rotary shaft 42. By reason of their weights, pulleys 40 and 41 act as flywheels for the rotary shaft 42. This provides a synchronous drive for the opposite eccentric mechanisms for operating the doffer comb. In accomplishing this purpose, there is a separate end support shaft 43, 44 journaled in sealed ball bearings 45, 46 in a housing formed in the upper portion of the frames 29, 29.

Pulleys 40 and 41 are mounted on the shafts 43, 44 respectively, thus coupling the latter to stub portion 47.

Shaft 43 and the stub portion 47 are each provided with aligned keyways 48, and receive the key 49. The key is held in position by means such as screws, and serves as a rigid connection between the end support shafts 43, 44 and the intermediate tubular portion. This tubular portion comprises a steel tube 49. The tube 49 is mounted on inner flanges of the stub portions 47, as best shown in FIGURE 4.

The outer portion of each end support shaft 43, 44 is provided with an eccentric 90. This eccentric cooperates with a connecting rod 51, 52. The connecting rods are formed of two members joined together by rivets or other suitable means which include bearings 53, 54, 55 and 56. This is a particularly advantageous light weight but sturdy connecting rod, especially easy of manufacture. There is a snap ring 57 which is snapped into a suitable annular groove 58 provided in the eccentric portion 50 of each end support 43, 44, thus holding the connecting rod firmly in place.

Mounted on the outer end of each of the eccentric portions 50 is counterweight 59 for balancing the reciprocating motion of the connecting rods.

The oscillating shaft assembly 60 is mounted below and laterally spaced from the rotary drive shaft 42. Like the latter, the oscillating shaft is comprised of a midportion and two end support shafts 61, 62, which are journaled in a pair of sealed ball bearings 63, 64. The outer portions of both end support shafts terminate in crank arms 65, 66, carrying crank studs 67, 68, to which is linked the lower ends of the connecting rods 51 and 52. The connecting rods are self-aligning and are locked in their aligned position by means of a split ring 69, riding on the beveled outer edge of the crank studs 67, 68. A thrust washer 70, the outside diameter thereof being smaller than the inside diameter of the raceway of the bearings 54, 56, contacts the split ring. The thrust washer 70 is backed by a screw 71 and forces the split ring upon the bevel of the crank stud, wedging it firmly between the latter and the raceway of the bearing 54, 56.

The oscillating shaft 60 is hollow, being made of a steel tube 72. At its ends, the tube 72 has flanges 73, 74, to which it is attached by soldering or other suitable means. The midportion of the shaft 60 also carries the comb 28 and the comb supporting means.

The flanges 73, 74 have a number of circularly oriented
slots 75, 76 spaced equidistantly from each other and from the center. Each of these flanges is provided with a pin 77 projecting from its center. These pins 77 are adapted to fit into suitable grooves, 78, provided at the inner faces of the shafts 61, 62. These grooves are continued in the flange portion of sleeve 80 as illustrated in FIGURE 3, and shown there as numeral 79. Said sleeve 80 is fitted over the inner end portions of the shafts 61, 62 and fastened thereto by a key 81 and a set screw 82.

The flanges 80 contain an equal number of holes 83 as there are slots 76 in the flanges 73, 74. Said holes 83 are in line with the slots and are adapted to receive mounting bolts 84 with nuts 85. This arrangement is a novel feature of the invention in that by loosening nuts 85, the oscillating shaft can be adjusted in either direction about its center to the limits of the slots. Further, upon removal of the bolts 84, the mid-portions of the oscillating shaft can be disengaged from the rest of the mechanism and can be removed without disturbing the set-up of the doffer comb oscillating mechanism. This means considerable saving in labor and machine time whenever the removal of the comb blade is called for.

The doffer comb 28 is made of light weight material, preferably hard-coat magnesium and is supported on the oscillating shaft 60 by two arms 86, 86, preferably spaced on the shaft 60 at points removed from its ends substantially one-fourth of its length. This conforms to the case in which oscillation of the ends of the comb 28 are simultaneous with the vibration of the midportion of the shaft. In other words, the center and ends of the comb form points of amplitude controlled by the attachment to the arms 86, 86 at the nodes.

The arms 86, 86 are preferably flat, thin steel plates, laminated in two layers and welded or otherwise joined together. These arms have a number of perforations which are relatively small with respect to the weight of the plate but with loss of strength. By using thin plates for each arm, the ends of the plate may be bent to provide right angle free ends extending in opposite directions to from a T support, as shown in FIGURE 7. This is in effect a balanced support for the comb. The blade of the comb 28 is secured to the arms 86 by screws, welds or other suitable means.

Suitably spaced along the length of the hollow, oscillating shaft are pairs of aligned openings 87, 88. The aperture 87 is fitted loosely with a bolt 89. This bolt is adjustable screw-threaded through a fibre lock nut 90. The head of the bolt 8- has a counterbore 91. This counterbore holds a steel ball 92 free to adjust itself rotatably.

A steel wire 93 is anchored to the ball 92 and extends through the tubular shaft 60 and for a considerable distance on the far side where it passes through the comb 28 and is anchored to the latter, as shown in FIGURES 13 and 14.

Each wire extends through a spacer sleeve 96 interposed between the oscillating shaft 60 and the comb blade 28. A steel plug 94 is tightly receive in the end of the spacer sleeve, adjacent the comb blade. Plug 94 is provided with a suitable passage pole for the wire 93 and serves to maintain alignment of the sleeve 96 with the wire 93. The opposite end of the spacer sleeve is wedge-shaped and the resulting angular end fits within a pair of small countersinks 88 horizontally flanking the wire exit hole 88 of the oscillating shaft, as shown in FIGURE 19. The wire 93 is covered with a vibration dampening coating 95 over the head of the bolt 89 and the plug 94. By partly unscrewing the bolt 89, the plug 94 is applied to the steel wire 93, thus placing the spacing sleeve 96 under compression. It therefore holds the comb 28 definitely spaced, but free to oscillate slightly in a vertical direction.

In order to maintain the comb perpendicular and at right angles to the sleeves 96, some sleeves carry a fixed bracket 97. Each bracket has a semicircular center portion with opposite wings 98, 98. Attachment of the brackets to the sleeves provides a rigid alignment of the parts.

The shaft 60 with the comb 28 and its support is unbalanced. In order to adequately counterbalance the shaft in motion, two counterweights 99, 99 are adjustable mounted on studs 100, 100, extending radially from the shaft and in a direction opposite to that of the comb 28.

By the arrangement described above, it is possible to accomplish the complicated objects of the invention in a novel and improved manner. In brief, it will be apparent that the mechanism avoids excessive wear due to increased speed. Further, the increased speed is effected without developing disturbing resonance.

In addition, the ability to replace the comb blade has been facilitated; the upper or drive shaft may be driven from either end at will, and suitable adjustable pulleys may multiply the ratio.

The preferred form of the invention having been described by way of example solely, it will be evident that minor changes in structure, proportion and material can be made within the scope of the appended claims.

What we claim is:
1. A doffer comb mechanism comprising a drive shaft, drive means therefor, a cam on each end of the drive shaft, a parallel comb shaft, parallel crank arms one on each end portion of the comb shaft, a connecting rod connecting each arm with one of said cams, said comb shaft having a central tubular portion, means for movably and adjustably attaching said central portion to the end portions, spaced arms on the central portion of the comb shaft, diametrically spaced from the crank arms, a comb blade mounted on the arms, a series of hollow spacers at uniformly spaced points on the comb blade and pivotally held on the near side of the comb shaft, wires from the comb blade running freely through the spacers and central portion of the comb shaft and means on the opposite side of the said portion for anchoring the wires under tension.
2. A mechanism as defined in claim 1 in which the drive shaft has a counterweight at each end opposite the cam.
3. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said shaft by attachment means and arranged in spaced relation thereto; said attachment means being spaced axially of the shaft ends, means for supplying driving force with identical motion to said shaft at both ends thereof, two arms extending transversely from said shaft, said arms alone carrying the comb blade at the node points of the fundamental resonance of the blade.
4. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said shaft and arranged in spaced relation thereto, driving means at both ends of said shaft, two arms extending transversely from said shaft, said arms defining means for supporting the comb blade only at the node points of the fundamental resonance of the comb blade, speaker means arranged between the comb blade and the oscillatory shaft, and means cooperating with said speaker means for keeping the comb blade, throughout its length, at a fixed distance from said oscillatory shaft.
5. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said oscillatory shaft by attachment means and arranged in spaced relation thereto; said attachment means being spaced axially of the shaft ends, and drive means for supplying an identical driving force to each end of said oscillatory shaft, said drive means comprising a single rotary shaft parallel to and substantially the same length as the oscillatory shaft, eccentrics on both ends of said rotary shaft, parallel crank arms on both ends of said oscillatory shaft, and connecting rods connecting each of said crank arms with one of said eccentrics.
6. A doffer comb mechanism according to claim 5, wherein said rotary shaft and said oscillatory shaft are
journaled in bearings disposed in spaced support members mounted on the carding machine.

7. A doffer comb mechanism according to claim 5, including spacer means arranged between said oscillatory shaft and the comb blade and means cooperating with said spacer means for keeping the comb blade at all points of its length at a fixed distance from said oscillatory shaft.

8. A doffer comb mechanism according to claim 5, wherein the rotary shaft has a counterweight at each end.

9. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said shaft and arranged in spaced relation thereto, and means for supplying drive force with identical motion to said shaft on both ends thereof; wherein the oscillatory shaft is formed with a central tubular portion and means for removably and adjustably attaching said central portion to the end portions, whereby adjustments of the position of the central tubular portion may be made relative to said end portions, or removal and replacement of said central tubular portion can be effected without disturbing the positioning of said end portions.

10. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said shaft and arranged in spaced relation thereto, driving means at both ends of said shaft, two arms extending transversely from said shaft, said arms carrying the comb blade at substantially the node points of the fundamental resonance of the comb blade, spacer means arranged between the comb blade and the oscillatory shaft, and means cooperating with said spacer means for keeping the comb blade throughout its length, at a fixed distance from the oscillatory shaft; wherein said spacer means are sleeves, and the means cooperating therewith for keeping the comb blade at a fixed distance are wires strung from the oscillatory shaft to the comb blade, said wires being pivotally anchored to the oscillatory shaft as for end and fastened to the comb blade at the other end and carrying said spacer sleeves.

11. A doffer comb mechanism according to claim 10, wherein the wires are pivotally anchored by means comprising a hollow bolt holding the end of the wire and adjustably tensioning same in the side of said oscillatory shaft.

12. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said shaft and arranged in spaced relation thereto, driving means at both ends of said shaft, two arms extending transversely from said shaft, said arms carrying the comb blade at substantially the node points of the fundamental resonance of the comb blade, spacer means arranged between the comb blade and the oscillatory shaft, and means cooperating with said spacer means for keeping the comb blade, throughout its length, at a fixed distance from the oscillatory shaft; wherein said spacer means are pivotally held for movement solely in a plane perpendicular to the axis of the oscillatory shaft.

13. In a doffer comb mechanism for carding machines, an oscillatory shaft, a comb blade attached to said oscillatory shaft and arranged in spaced relation thereto, and drive means at both ends of said oscillatory shaft, said drive means comprising a rotary shaft, eccentric on both ends of said rotary shaft, parallel crank arms on both ends of said oscillatory shaft, and connecting rods connecting each of said crank arms with one of said eccentrics; in which the oscillatory shaft has a plurality of counterweights diametrically disposed to the arms supporting the comb blade.

14. In a doffer comb mechanism comprising a drive shaft, a rotary shaft, eccentric on each end of the drive shaft, a parallel comb shaft, parallel crank arms, one on each end of the comb shaft, a connecting rod
connecting each arm with one of said cams, two arms on the comb shaft diametrically spaced from the crank arms, a comb blade mounted on the arms, said arms being spaced inwardly from the ends of the comb blade one-fourth of the length of the blade, a series of hollow spacers at uniformly spaced points on the comb blade and pivotally held on the near side of the comb shaft, wires from the comb blade running freely through the spacers and comb shaft, and means on the opposite side of the comb shaft for anchoring the wires under tension.

20. A doffer comb mechanism comprising a drive shaft, drive means therefor, a cam on each end of the drive shaft, a parallel comb shaft, parallel crank arms, one on each end of the comb shaft, a connecting rod connecting each arm with one of said cams, two spaced arms on the comb shaft, diametrically spaced from the crank arms, a comb blade mounted on the arms, a series of hollow spacers at uniformly spaced points on the comb blade and pivotally held on the near side of the comb shaft, wires from the comb blade running freely through the spacers and comb shaft and means on the opposite side of the comb shaft for anchoring the wires under tension.

21. A mechanism as defined in claim 20 in which the hollow spacers are pivotally held for movement solely in a plane perpendicular to the axis of the comb shaft.

22. A mechanism as defined in claim 20 in which the means for anchoring the wires comprises a hollow bolt holding the end of the wire and adjustably tensioned in the side of the comb shaft.

23. A mechanism as defined in claim 20 in which the wires have a vibration dampening cover throughout their length.

24. A mechanism as defined in claim 20 in which the spacers are aligned to the comb shaft by winged brackets.

25. A mechanism as defined in claim 20 in which the comb shaft has a plurality of counterweights diametrically disposed to the arms of the comb shaft.

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