Looking at Foreign Auto-doffers through Their Patents

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1. Introduction

There is a worldwide race among spinners and spinning frame makers for research and development of new methods and equipment for modernized, automated and continuous spinning. An automatic doffer for spinning frames and twisting machines has been thought the most labor-saving equipment, but no satisfactory result has been obtained.

In what follows the authors introduce foreign auto-doffers, their types and characteristics as revealed by their patents. It is hoped this little study will be of help in future research and development.

2. Doffing of Spinning Frame

Doffing of a spinning frame can be divided into three main types:

1. Hand doffing
2. Self-doffing
3. Automatic doffing

Hand doffing is the type most commonly used. A self-doffer is attached to a spinning frame and grips and removes full bobbins from the spindle by the operation of a lever or a handle. Empty bobbins are placed on spindles by an empty-bobbin supporter. Self-doffers of this type are extensively used, especially for wool and hemp spinning frames. Patents for self-doffers were obtained in fairly old times.

Automatic doffers vary widely in type. There is a type attached to a spinning frame for fully automatic, simultaneous doffing. There is one that lifts full bobbins off spindles by means of another device (e.g., a crane). A third travels along the sides of the spinning frame and doffs the frame. A fourth stops temporarily for doffing during its movement. There are many others. These include single- and multi-spindle types.

The authors are not sure how many patents there are for each type, but there are many U.S. patents for the crane type and many European for the fixed-to-frame, simultaneous type. There are both

U.S. and European patents for wagon-type doffers. The following paragraphs classify foreign auto-doffers and trace the histories of their developments in the light of their patents.

3. Self-doffing

Fig. 1 Stell's doffer

There are four known types of self-doffers: Aked Prince Smith (A.P.S.), Boyd Taylor, Revolving Spindle Doffer (R.S.D.), and Stell's Doffer. Stell's, invented in 1024 by Alfred Stell, Johon Stell, Henry Helch, is illustrated in Fig. 1.

The four types are mainly for cap-spinning or hemp-spinning. They differ from a type that is now engaging attention and is due to be researched into. Some self-doffers can be used on existing machines. The doffer invented in 1919 by Swiss Frederik Graf and shown in Fig. 2 is one of them.

Fig. 2(a) illustrates the side cross section of Graf's doffer. Fig. 2(b) is an enlarged front view. Full bobbins are gripped by the operation of the

Fig. 2(a) Side view of Graf's doffer

Fig. 2(b) Enlarged front view and cross section of Graf's doffer

lower handle and removed by the operation of the upper handle. Empty bobbins are reversed and put on spindles. The whole doffer is tilted by the operation of a handle. Although entirely hand-operated, it is a novel idea.

In 1926, a machine to lift full bobbins and replace them with empty bobbins was invented by a group of Americans, including A. E. Smith. It is illustrated in Fig. 3. Full bobbins are hooked and lifted by the operation of a lever handle. A tube

Fig. 2(c) Graf's doffer

Fig. 3(a) Smith et al.'s doffer

containing empty bobbins is reversed to release and put them on spindles.

Full bobbins on this machine are pressure-gripped between plates. This is likely to damage the yarn. The machine is, therefore, not considered serviceable. Nor do the authors believe smooth operation is possible by the handle alone. This kind of spinning frame and hand doffer will, however, serve as a historical guide to those who seek to develop fully automatic doffers.

Fig. 3(b) Smith et al.'s doffer

4. Automatic Doffing

Auto-doffers are of three different types: the fixed-to-frame type attached to the spinning frame, the crane type and the wagon type.

(A) Fixed-to-frame Doffer

In 1924, an improved automatic doffer was invented by American William W. Miller.

Miller's is similar to the self-doffer as illustrated in Fig. 4, but it was classed as an auto-doffer because it was not manually operated. One of the improvements was that removing full bobbins was made easy by lifting the base without damaging the yarns before the bobbins were gripped. Another was a conveyor provided to arrange empty bobbins. Miller's doffer should, after all, be included in the old types and does not merit attention.

In 1949, James Jackson Haythornthwaite invented a doffing mechanism for spinning frames and twisting machines and improved further. His invention was intended more for the manufacture of spinning frames including an automatic doffer, than for use on conventional spinning machines. Fig. 5 shows J. J. Haythornthwaite's doffer.

Haythornthwaite's inventions are patented in Japan, so there is no need to specifically explain them. Their features may be summed up as

Fig. 4(a) Miller's doffing device

Fig. 4(b) Miller's doffing device

follows: A spinning frame includes stationary ring rails and vertically movable spindle rails. The stationary ring rails are fitted with a device to hook the bottoms of full bobbins. The spindle rails are lowered to remove full bobbins from the spindles and drop them forward onto the conveyor for transfer into the box located at the end of the conveyor. The lifting of the spindle rails, which are fixed to a chain belt, does not seem intended merely for doffing.

Conceivably, a spinning frame equipped with such a doffer may emerge at this time when higher and higher productivity is required.

Fig. 5(a) J. J. Haythornthwaite's doffing mechanism

Fig. 5(b) J. J. Haythornthwaite's doffing mechanism

What interest us most about Haythornthwaite's equipment are its device to grip and cut the loose ends of bobbin yarns and doffing coil formers. They have been improved steadily. The loose end gripper-cutter was successively improved as shown in Figs. 6 and 7, in 1950. This system, however, requires a special spinning frame and cannot be used on conventional spinning frames. It serves as a good guide, however, to manufacturing spinning frames in new designs.

Haythornthwaite's improved doffing mechanism should be rated high, after all, because the other doffers introduced in the foregoing paragraphs are unequipped to control and separate yarn. This means

Fig. 6

J. J. Haythornthwaite's improved doffing mechanism

Fig. 7

J. J. Haythornthwaite's improved doffing mechanism

Fig. 5(c) J. J. Haythornthwaite's doffing mechanism

Fig. 8(a) J. J. Colvin's doffer

Fig. 8(c) J. J. Colvin's doffer

(B) Crane Type Auto-doffer

A typical crane type doffer — a bobbin-changing device — was invented by a German, H. Buddecke, in 1927. Patents for it were applied for in Switzerland and U.S. in 1929. This invention constitutes the keynote of the auto-doffers now made by Deering Milliken Res. Corp. It is illustrated in Fig. 9.

The Buddecke doffer uses hollow rubber bodies and compressed air to grip full bobbins. The doffer is supported on the crane to do simultaneous doffing. Both empty and full bobbins are put in a creel on the spindle rails. Fig. 10 illustrates the gripping element which uses sponge, not compressed air.

Fig. 10

Fig. 11

Fig. 11 shows the full-bobbin grippers which put the pads from both sides. This is the opposite of the conventional means.

Although this invention has been around for a long time, Deering Milliken Res. Corp., presumably had multiple problems to overcome before they perfected a service machine. As if to bear out this surmise, new partial improvements and new inventions have been made and patents obtained for them. A number of new inventions related to attachments have also been made. For instance, in 1958, Robert M. Ingham, Jr. invented (1) a bobbin-removing and

Fig. 9 H. Buddecke's doffer

Fig. 12 R. M. Ingham, Jr.'s bobbin removing device

placing device, (2) a device to remove full bobbins from the spindles (Figs. 12, 13), (3) a bobbin-end gripping device (Fig. 14), and, as attachments, (4) a bobbin feeder (Fig. 15) and (5) a bobbin adjuster (Fig. 16). They are patented in Japan. They

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(C) Wagon Type Auto-doffer

(Continuous movement)

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In 1957, the doffer illustrated in Fig. 17 was invented by Spaniard R. Escursell Prat, and was

Fig. 16 R. M. Ingham, Jr.'s bobbin adjuster

Fig. 17(a) R. Escursell Prat's doffer

Fig. 17(b) R. Escursell's doffer

Fig. 18(a)

patented in Japan. This device has been examined by many and, therefore, needs hardly any explanation. The method used to pull out bobbins for controlling, separating and moving the yarn seems to leave room for improvement. Prat invented another type of doffer in 1957 (illustrated in Fig. 18). It is practically the same as the earlier type, except for the empty bobbin feeder.

(D) Wagon Type Auto-doffer

(Intermittent movement)

This is a type which is engaging the greatest

public attention. Each Company's research and development efforts are apparently being made along the lines of this type. Its major advantages are relatively low equipment cost and ease of maintenance. It can be divided into single- and multi-spindle types. The single-spindle type, however, is rather limited in production. Because it is almost the same in build as the multiple-spindle type. We shall make no distinction between the two in this article.

Fig. 18(b)

Fig. 18(c) Bobbin feeder

The wagon type seems to have been conceived fairly long ago. A yarn controller and separator for spinning frames (Fig. 19) was invented by American J. E. Tichon et al. as long ago as 1901. It controls and separates yarn on doffing. Its chain has a gripping element which gradually doffs the frame and winds yarn on fresh empty bobbins.

Fig. 19 J. E. Tichon et al's yarn controller and separator

The Tichon group invented also a doffer and obtained a patent for it. The new invention, shown in Fig. 20, is a single-spindle, continuous movement type doffer with a bobbin-gripper-raising chain which tilts and properly uses its own horizontal and vertical movements. Of special interest is its empty bobbin magazine which feeds bobbins one by one as it moves. This invention doubtless attracted the attention of the industry when it was announced, but it was not put into service, to the best of the authors' knowledge.

In 1908, a doffer was invented by Americans H. D. Colman and B. A. Peterson. The device, illustrated in Fig. 21, is a single-spindle, intermittent movement type. An explanation of its part which moves and ties up with the spindle and then stops is omitted here. A lever projected by cam action ties up with the spindle bolster and then stops.

An interesting feature of this invention is that the doffer tube moves vertically and holds full bobbins.

Another feature is that the donning tube discharges empty bobbins onto spindles. Certainly, full bobbins make no obstacle if covered with the tube and then pulled out. Yarn breaks during operation can be prevented that way. The vertical lifting enables comparatively positive winding of yarn on spindles.

In 1909, a doffing machine, illustrated in Fig. 22, was invented by American A. G. Boozer, Jr. et al.

Fig. 20 J. E. Tichon and H. S. Foster's doffer

It is of a single-spindle wagon type and has a rotary magazine to hold empty bobbins. The magazine is made compact to save space. This is the only interesting feature. This invention seems too complicated to be serviceable.

In 1913, they invented an improved doffing machine, shown in Fig. 23. This is equipped with a motor for fully automatic operation. The bobbin grippers are of a from-both-sides gripping type. A donning tube is used to place empty bobbins on spindles.

Fig. 21(a) Front view of H. D. Colman and B. A. Peterson's doffer

Fig. 21(b) Bobbin grippers and feeder on H. D. Colman and B. H. Peterson's doffer

In 1922, American H.C. Miller invented a multiple-spindle type doffer, illustrated in Fig. 24. As is clear from the figure, it is not fully automatic, but it has features worthy of mention. For one thing,

its full bobbin gripper is pinched by springs. For another, bobbins from the magazine are gripped and placed one by one on spindles. The loose ends of bobbin yarn are gripped securely.

Fig. 22 A. G. Boozer, Jr. and G. Hill's doffer

Fig. 23(a) A.G. Boozer, Jr. and G. Hill's improved doffing machine

Fig. 23(b) A.G. Boozer, Jr. and G. Hill's improved doffing machine

Fig. 24(a) H. C. Miller's doffer

In 1925, a doffing device was invented in England by R. B. Buchanan. See Fig. 25. This invention was patented in Japan, too, and is undoubtedly familiar to many. Although Buchanan's doffer serves as a guide in point of mechanism, it is not quite serviceable as it is, because full bobbins have to be pinched by springs to be lifted.

Fig. 24(b) H.C. Miller's doffer

Fig. 24(c) H.C. Miller's doffer

In 1944, a doffer was invented in England by G. A. R. Foster et al. A picture of it is shown here. It was widely noticed in the industry at the time and was introduced in the Japanese edition of this

Fig. 24(d) H.C. Miller's doffer

Fig. 25 R.B. Buchanan's doffing device

informed that the institute had used it for a while and then granted the manufacturing licence to T.M.M., who manufactured a few units under the licence, then suspended further production.

The doffer is well-built and works well, but its complicated build, led to many difficulties and relegated it to the limbo of the half-forgotten. This point is illustrated in Fig. 26. The invention is patented in Japan and require no further explanations. The method used in it for empty bobbin supply, a method carefully designed for smooth yarn control and separation, will serve as a good guide. The need of a special bobbins for gripping may have been one reason why this doffer has not been widely used.

In 1949, a doffer was invented by another Englishman, H. Partington. As shown in Fig. 27, its component parts are delicately built for easy yarn control and separation and easy bobbin supply.

Fig. 27(a) H. Partington's doffer

Fig. 27(b) H. Partington's doffer

Fig. 27(c) H. Partington's doffer

Fig. 27(d) H. Partington's doffer

If the conventional hand doffing were mechanized, the doffer would be very complicated and subject to frequent troubles. Partington's doffer may also have such troubles and might not be in practical service as a useful machine.

Fig. 27(e) H. Partington's doffer

5. Chronology

The automatic doffer listed in section 4 are classified chronologically and by types, as shown below.

6. To Conclude :

The authors are aware this story, based on meager data, is far from complete. They classified the available data as best they could. Space prevented a detailed explanation of every doffer. Readers are kindly asked to substitute the illustrations for explanation. The authors will be happy if this little story serves as a guide to those interested in research and development of automatic doffers.

Year	Frame-fixed type		Crane type	Wagon type	
1901				J.E. Tichon et al.	U.S.P. 691677 U.S.P. 745466
1908				H.D. Colman et al.	U.S.P. 1062439
1909				A.G. Boozer, Jr.	U.S.P. 1142011
1913				A.G. Boozer, Jr. et al.	U.S.P. 1142748
1919	F. Graf	U.S.P. 1384449			
1921	W.W. Miller	U.S.P. 1463479			
1922				H.C. Miller	U.S.P. 1669769
1924	A. Stell et al.	U.S.P. 1579257			
1925				R.B. Buchanan	U.S.P. 1572103
1926	A.E. Smith et al.	U.S.P. 1608912			
1927			H. Buddecke	U.S.P. 1810754	
1944				G.A.R. Foster et al.	U.S.P. 2449742
1948	E.J. Verron Rigg	U.S.P. 2564280			
1949	J.J. Haythornthwaite	U.S.P. 2582696		H. Partington	U.S.P. 2653440
1951	J.J. Colvin	U.S.P. 2716326			
1957				R. Escurcell	U.S.P. 2961822
1958			R.M. Ingham, Jr.		3103096