I. CONVERSION OF CENTIGRADE INTO RÉAUMUR OR FAHRENHEIT.

C.	R.	F.	C.	R.	F.	C.	R.	F.
0°	0°	32°	**34°**	27.2°	93.2°	**68°**	54.4°	154.4°
1	0.8	33.8	**35**	28	95	**69**	55.2	156.2
2	1.6	35.6	**36**	28.8	96.8	**70**	56	158
3	2.4	37.4	**37**	29.6	98.6	**71**	56.8	159.8
4	3.2	39.2	**38**	30.4	100.4	**72**	57.6	161.6
5	4	41	**39**	31.2	102.2	**73**	58.4	163.4
6	4.8	42.8	**40**	32	104	**74**	59.2	165.2
7	5.6	44.6	**41**	32.8	105.8	**75**	60	167
8	6.4	46.4	**42**	33.6	107.6	**76**	60.8	168.8
9	7.2	48.2	**43**	34.4	109.4	**77**	61.6	170.6
10	8	50	**44**	35.2	111.2	**78**	62.4	172.4
11	8.8	51.8	**45**	36	113	**79**	63.2	174.2
12	9.6	53.6	**46**	36.8	114.8	**80**	64	176
13	10.4	55.4	**47**	37.6	116.6	**81**	64.8	177.8
14	11.2	57.2	**48**	38.4	118.4	**82**	65.6	179.6
15	12	59	**49**	39.2	120.2	**83**	66.4	181.4
16	12.8	60.8	**50**	40	122	**84**	67.2	183.2
17	13.6	62.6	**51**	40.8	123.8	**85**	68	185
18	14.4	64.4	**52**	41.6	125.6	**86**	68.8	186.8
19	15.2	66.2	**53**	42.4	127.4	**87**	69.6	188.6
20	16	68	**54**	43.2	129.2	**88**	70.4	190.4
21	16.8	69.8	**55**	44	131	**89**	71.2	192.2
22	17.6	71.6	**56**	44.8	132.8	**90**	72	194
23	18.4	73.4	**57**	45.6	134.6	**91**	72.8	195.8
24	19.2	75.2	**58**	46.4	136.4	**92**	73.6	197.6
25	20	77	**59**	47.2	138.2	**93**	74.4	199.4
26	20.8	78.8	**60**	48	140	**94**	75.2	201.2
27	21.6	80.6	**61**	48.8	141.8	**95**	76	203
28	22.4	82.4	**62**	49.6	143.6	**96**	76.8	204.8
29	23.2	84.2	**63**	50.4	145.4	**97**	77.6	206.6
30	24	86	**64**	51.2	147.2	**98**	78.4	208.4
31	24.8	87.8	**65**	52	149	**99**	79.2	210.2
32	25.6	89.6	**66**	52.8	150.8	**100**	80	212
33	26.4	91.4	**67**	53.6	152.6			

II. CONVERSION OF RÉAUMUR INTO CENTIGRADE OR FAHRENHEIT.

R.	*C.*	*F.*	*R.*	*C.*	*F.*	*R.*	*C.*	*F.*
0°	0°	32°	**27°**	33.75°	92.75°	**54°**	67.5°	153.5°
1	1.25	34.25	**28**	35	95	**55**	68.75	155.75
2	2.5	36.5	**29**	36.25	97.25	**56**	70	158
3	3.75	38.75	**30**	37.5	99.5	**57**	71.25	160.25
4	5	41	**31**	38.75	101.75	**58**	72.5	162.5
5	6.25	43.25	**32**	40	104	**59**	73.75	164.75
6	7.5	45.5	**33**	41.25	106.25	**60**	75	167
7	8.75	47.75	**34**	42.5	108.5	**61**	76.25	169.25
8	10	50	**35**	43.75	110.75	**62**	77.5	171.5
9	11.25	52.25	**36**	45	113	**63**	78.75	173.75
10	12.5	54.5	**37**	46.25	115.25	**64**	80	176
11	13.75	56.75	**38**	47.5	117.5	**65**	81.25	178.25
12	15	59	**39**	48.75	119.75	**66**	82.5	180.5
13	16.25	61.25	**40**	50	122	**67**	83.75	182.75
14	17.5	63.5	**41**	51.25	124.25	**68**	85	185
15	18.75	65.75	**42**	52.5	126.5	**69**	86.25	187.25
16	20	68.	**43**	53.75	128.75	**70**	87.5	189.5
17	21.25	70.25	**44**	55	131	**71**	88.75	191.75
18	22.05	72.5	**45**	56.25	133.25	**72**	90	194
19	23.75	74.75	**46**	57.5	135.5	**73**	91.25	196.25
20	25	77	**47**	58.75	137.75	**74**	92.5	198.5
21	26.25	79.25	**48**	60	140	**75**	93.75	200.75
22	27.5	81.5	**49**	61.25	142.25	**76**	95	203
23	28.75	83.75	**50**	62.5	144.5	**77**	96.25	205.25
24	30	86	**51**	63.75	146.75	**78**	97.5	207.5
25	31.25	88.25	**52**	65	149	**79**	98.75	209.75
26	32.5	90.5	**53**	66.25	151.25	**80**	100	212

III. CONVERSION OF FAHRENHEIT INTO CENTIGRADE OR RÉAUMUR.

F.	*C.*	*R.*	*F.*	*C.*	*R.*	*F.*	*C.*	*R.*
0°	—17.78°	—14.22°	71°	21.67°	17.33°	142°	61.11°	48.89°
1	17.22	13.78	72	22.22	17.78	143	61.67	49.33
2	16.67	13.33	73	22.78	18.22	144	62.22	49.78
3	16.11	12.89	74	23.33	18.67	145	62.78	50.22
4	15.55	12.44	75	23.89	19.11	146	63.33	50.67
5	15	12	76	24.44	19.56	147	63.89	51.11
6	14.44	11.56	77	25	20.	148	64.44	51.56
7	13.89	11.11	78	25.55	20.44	149	65	52
8	13.33	10.67	79	26.11	20.89	150	65.55	52.44
9	12.78	10.22	80	26.67	21.33	151	66.11	52.89
10	12.22	9.78	81	27.22	21.78	152	66.67	53.33
11	11.67	9.33	82	27.78	22.22	153	67.22	53.78
12	11.11	8.89	83	28.33	22.67	154	67.78	54.22
13	10.55	8.44	84	28.89	23.11	155	68.33	54.67
14	10	8	85	29.44	23.56	156	68.89	55.11
15	9.44	7.56	86	30	24	157	69.44	55.56
16	8.89	7.11	87	30.55	24.44	158	70	56
17	8.33	6.67	88	31.11	24.89	159	70.55	56.44
18	7.78	6.22	89	31.67	25.33	160	71.11	56.89
19	7.22	5.78	90	32.22	25.78	161	71.67	57.33
20	6.67	5.33	91	32.78	26.22	162	72.22	57.78
21	6.11	4.89	92	33.33	26.67	163	72.78	58.22
22	5.55	4.44	93	33.89	27.11	164	73.33	58.67
23	5	4	94	34.44	27.56	165	73.89	59.11
24	4.44	3.56	95	35	28	166	74.44	59.56
25	3.89	3.11	96	35.55	28.44	167	75	60
26	3.33	2.67	97	36.11	28.89	168	75.55	60.44
27	2.78	2.22	98	36.67	29.33	169	76.11	60.89
28	2.22	1.78	99	37.22	29.78	170	76.67	61.33
29	1.67	1.33	100	37.78	30.22	171	77.22	61.78
30	1.11	0.89	101	38.33	30.67	172	77.78	62.22
31	0.55	0.44	102	38.89	31.11	173	78.33	62.67
32	0	0	103	39.44	31.56	174	78.89	63.11
33	+0.55	+0.44	104	40	32	175	79.44	63.56
34	1.11	0.89	105	40.55	32.44	176	80	64
35	1.67	1.33	106	41.11	32.89	177	80.55	64.44
36	2.22	1.78	107	41.67	33.33	178	81.11	64.89
37	2.78	2.22	108	42.22	33.78	179	81.67	65.33
38	3.33	2.67	109	42.78	34.22	180	82.22	65.78
39	3.89	3.11	110	43.33	34.67	181	82.78	66.22
40	4.44	3.56	111	43.89	35.11	182	83.33	66.67
41	5	4	112	44.44	35.56	183	83.89	67.11
42	5.55	4.44	113	45	36	184	84.44	67.56
43	6.11	4.89	114	45.55	36.44	185	85	68
44	6.67	5.33	115	46.11	36.89	186	85.55	68.44
45	7.22	5.78	116	46.67	37.33	187	86.11	68.89
46	7.78	6.22	117	47.22	37.78	188	86.67	69.33
47	8.33	6.67	118	47.78	38.22	189	87.22	69.78
48	8.89	7.11	119	48.33	38.67	190	87.78	70.22
49	9.44	7.56	120	48.89	39.11	191	88.33	70.67
50	10	8	121	49.44	39.56	192	88.89	71.11
51	10.55	8.44	122	50	40	193	89.44	71.56
52	11.11	8.89	123	50.55	40.44	194	90	72
53	11.67	9.33	124	51.11	40.89	195	90.55	72.44
54	12.22	9.78	125	51.67	41.33	196	91.11	72.89
55	12.78	10.22	126	52.22	41.78	197	91.67	73.33
56	13.33	10.67	127	52.78	42.22	198	92.22	73.78
57	13.89	11.11	128	53.33	42.67	199	92.78	74.22
58	14.44	11.56	129	53.89	43.11	200	93.33	74.67
59	15	12	130	54.44	43.56	201	93.89	75.11
60	15.55	12.44	131	55	44	202	94.44	75.56
61	16.11	12.89	132	55.55	44.44	203	95	76
62	16.67	13.33	133	56.11	44.89	204	95.55	76.44
63	17.22	13.78	134	56.67	45.33	205	96.11	76.89
64	17.78	14.22	135	57.22	45.78	206	96.67	77.33
65	18.11	14.67	136	57.78	46.22	207	97.22	77.78
66	18.89	15.11	137	58.33	46.67	208	97.78	78.22
67	19.44	15.56	138	58.89	47.11	209	98.33	78.67
68	20	16	139	59.44	47.56	210	98.89	79.11
69	20.55	16.44	140	60	48.	211	99.44	79.56
70	21.11	16.89	141	60.55	48.44	212	100	80

HYDROMETERS AND SPECIFIC GRAVITY.

The concentration of a liquid such as sulphuric acid, or the amount of solid substance present in such a solution as nitrate of iron, may frequently be measured by a determination of the *density* or *specific gravity* of the solution. This is most accurately done by weighing a known volume of the liquid, since the specific gravity of any substance is represented by the weight of that substance compared with the weight of an equal volume of water, the latter being taken as unity.

Thus :— 50 cubic centimetres of water weigh 50 grammes.
50 cubic centimetres of sulphuric acid weigh 92 grammes.

Therefore the weight of sulphuric acid compared with water is as 92 : 50 and the specific gravity $= \frac{92}{50} \times 1 = 1.84$

The determination of specific gravity by this method necessitates the use of accurately gauged instruments, and requires considerable time and a certain degree of manipulative skill. For use in a dye-house, a simpler and more expeditious process is therefore desirable, and such is found in the use of the instruments known as *hydrometers* or *aereometers*, which, by simple immersion in the liquid, show directly on a scale the approximate specific gravity.

The instrument depends for its action upon the obvious fact that the denser (heavier) a liquid is the heavier the float which it will support. It takes the form of a weighted bulb supporting an upright graduated scale, a series of such instruments being so weighted that the stem of No 2 is almost entirely immersed in a liquid which floats No. 1—which is lighter—so high that the scale is nearly all above the surface of the liquid. No. 3 also is correspondingly heavier than No. 2 ; No. 4 than No. 3, etc.; one set of instruments, usually six in number, thus constituting a complete scale of sufficiently wide range to include all common liquids and solutions.

The method of graduating the scale varies in different instruments. One form is arranged to indicate directly the actual specific gravity, such being known as *specific gravity hydrometers*, but those most commonly in use are graduated with an empirical scale.

In England *Twaddell's scale* is commonly employed, and this bears a definite ratio to specific gravity; but on the continent of Europe, and in America, *Baumé's hydrometer* is chiefly used, and the readings on this scale cannot be converted into specific gravity without the use of a complicated formula or reference to a table. A revised Baumé scale is now in limited use, and this, which is known as the *rational Baumé scale*, is directly convertible into specific gravity by means of a simple formula.

Other scales have been proposed and are met with occasionally, such as those of Beck, Cartier, Balling and Gay-Lussac. All these bear a definite relationship to specific gravity, and a table is given below by means of which any particular scale may be converted into specific gravity, or, indirectly, into another more convenient scale.

Hydrometer Scale.	*Formula for converting into Specific Gravity* (*Sp. gr.*).
1. Specific gravity hydrometer	Gives direct readings.
2. Twaddell's hydrometer	Sp. gr. $= \frac{0\ 5\ \text{N} + 100}{100}$
3. Rational Baumé	Sp. gr. $= \frac{146.3}{146.3 - \text{N.}}$
4. Beck's hydrometer	Sp. gr. $= \frac{170}{170 - \text{N.}}$
5. Cartier's hydrometer	Sp. gr. $= \frac{136.8}{136.8 - \text{N.}}$
6. Balling's hydrometer	Sp. gr. $= \frac{200}{200 - \text{N.}}$
7. Gay-Lussac's hydrometer	Sp. gr. $= \frac{100}{100 - \text{N.}}$

In the above formulæ, N = the particular degree which it is desired to convert. Thus, to change 168° Tw. in Sp. gr. :—

$$\frac{168 \times 0.5 + 100}{100} = 1.84 \text{ Sp. gr.}$$

$$25° \text{ Beck} = \frac{170}{170 - 25} = 1.172 \text{ Sp. gr.}$$

$$30° \text{ Rational Baumé} = \frac{146.3}{146.3 - 30} = 1.258 \text{ Sp. gr.}$$

In specific gravity determinations, two facts must be kept in view, viz., that the presence of a second substance in solution entirely vitiates any inference which may be drawn with regard to the amount of the principal ingredient; and, secondly, that the specific gravity is greatly influenced by the temperature at which the experiment is made. Thus, if a sample of nitrate of iron is adulterated with sodium sulphate, it may show a high specific gravity and yet be weak in iron; or, again, to illustrate the effect of temperature, aniline oil will sink in cold water, because it is heavier at low temperatures; but if the mixture is heated, the oil will rise to the surface and float, because, as it expands more quickly than water, it becomes lighter at high temperatures.

The determination of specific gravity should therefore always be made at as near 15° C. (60° F.) as possible; this being taken as the standard temperature for such determinations.

COMPARISON BETWEEN SPECIFIC GRAVITY AND DEGREES.—Twaddell and Baumé.

Tw.	*B.*	*Sp. gr.*	*Tw.*	*B.*	*Sp. gr.*	*Tw.*	*B.*	*Sp. gr.*
1°	0.7°	1.005	59°	32.8°	1.295	117°	53.3°	1.585
2	1.4	1.010	60	33.3	1.300	118	53.6	1.590
3	2.1	1.015	61	33.7	1.305	119	53.9	1.595
4	2.7	1.020	62	34.2	1.310	120	54.1	1.600
5	3.4	1.025	63	34.6	1.315	121	54.4	1.605
6	4.1	1.030	64	35	1.320	122	54.7	1.610
7	4.7	1.035	65	35.4	1.325	123	55	1.615
8	5.4	1.040	66	35.8	1.330	124	55.2	1.620
9	6	1.045	67	36.2	1.335	125	55.5	1.625
10	6.7	1.050	68	36.6	1.340	126	55.8	1.630
11	7.4	1.055	69	37	1.345	127	56	1.635
12	8	1.060	70	37.4	1.350	128	56.3	1.640
13	8.7	1.065	71	37.8	1.355	129	56.6	1.645
14	9.4	1.070	72	38.2	1.360	130	56.9	1.650
15	10	1.075	73	38.6	1.365	131	57.1	1.655
16	10.6	1.080	74	39	1.370	132	57.4	1.660
17	11.2	1.085	75	39.4	1.375	133	57.7	1.665
18	11.9	1.090	76	39.8	1.380	134	57.9	1.670
19	12.4	1.095	77	40.1	1.385	135	58.2	1.675
20	13	1.100	78	40.5	1.390	136	58.4	1.680
21	13.6	1.105	79	40.8	1.395	137	58.7	1.685
22	14.2	1.110	80	41.2	1.400	138	58.9	1.690
23	14.9	1.115	81	41.6	1.405	139	59.2	1.695
24	15.4	1.120	82	42	1.410	140	59.5	1.700
25	16	1.125	83	42.3	1.415	141	59.7	1.705
26	16.5	1.130	84	42.7	1.420	142	60	1.710
27	17.1	1.135	85	43.1	1.425	143	60.2	1.715
28	17.7	1.140	86	43.4	1.430	144	60.4	1.720
29	18.3	1.145	87	43.8	1.435	145	60.6	1.725
30	18.8	1.150	88	44.1	1.440	146	60.9	1.730
31	19.3	1.155	89	44.4	1.445	147	61.1	1.735
32	19.8	1.160	90	44.8	1.450	148	61.4	1.740
33	20.3	1.165	91	45.1	1.455	149	61.6	1.745
34	20.9	1.170	92	45.4	1.460	150	61.8	1.750
35	21.4	1.175	93	45.8	1.465	151	62.1	1.755
36	22	1.180	94	46.1	1.470	152	62.3	1.760
37	22.5	1.185	95	46.4	1.475	153	62.5	1.765
38	23	1.190	96	46.8	1.480	154	62.8	1.770
39	23.5	1.195	97	47.1	1.485	155	63	1.775
40	24	1.200	98	47.4	1.490	156	63.2	1.780
41	24.5	1.205	99	47.8	1.495	157	63.5	1.785
42	25	1.210	100	48.1	1.500	158	63.7	1.790
43	25.5	1.215	101	48.4	1.505	159	64	1.795
44	26	1.220	102	48.7	1.510	160	64.2	1.800
45	26.4	1.225	103	49	1.515	161	64.4	1.805
46	26.9	1.230	104	49.4	1.520	162	64.6	1.810
47	27.4	1.235	105	49.7	1.525	163	64.8	1.815
48	27.9	1.240	106	50	1.530	164	65	1.820
49	28.4	1.245	107	50.3	1.535	165	65.2	1.825
50	28.9	1.250	108	50.6	1.540	166	65.5	1.830
51	29.3	1.255	109	50.9	1.545	167	65.7	1.835
52	29.7	1.260	110	51.2	1.550	168	65.9	1.840
53	30.2	1.265	111	51.5	1.555	169	66.1	1.845
54	30.6	1.270	112	51.8	1.560	170	66.3	1.850
55	31.1	1.275	113	52.1	1.565	171	66.5	1.855
56	31.5	1.280	114	52.4	1.570	172	66.7	1.860
57	32	1.285	115	52.7	1.575	173	67	1.865
58	32.4	1.290	116	53	1.580			

THE ELEMENTS WITH THEIR SYMBOLS AND ATOMIC WEIGHTS.

	Name.	Symbol.	Atomic Weight.		Name.	Symbol.	Atomic Weight.
1	**Aluminium**	**Al.**	**27.1**	36	Nickel	Ni.	58
2	**Antimony (Stibium)**	**Sb.**	**120**	37	Niobium	Nb.	94.2
3	Arsenic	As.	75	**38**	**Nitrogen**	**N.**	**14**
4	Barium	Ba.	137	39	Osmium	Os.	192
5	Berylium	Be.	9.1	**40**	**Oxygen**	**O.**	**16**
6	Bismuth	Bi.	208	41	Palladium	Pd.	106
7	Boron	B.	11	42	Phosphorous	P.	31
8	Bromine	Br.	80	43	Platinum	Pt.	194.8
9	Cadmium	Cd.	112.1	**44**	**Potassium (Kalium)**	**K.**	**39.1**
10	Cæsium	Cs.	132.9	45	Rhodium	Rh.	103
11	**Calcium**	**Ca.**	**40**	46	Rubidium	Rb.	85.4
12	**Carbon**	**C.**	**12**	47	Ruthenium	Ru.	103.8
13	Cerium	Ce.	140.2	48	Samarium	Sa.	150
14	**Chlorine**	**Cl.**	**35.5**	49	Scandium	Sc.	44.1
15	**Chromium**	**Cr.**	**52.3**	50	Selenium	Se.	79.1
16	Cobalt	Co.	59	51	Silicon	Si.	28.4
17	**Copper**	**Cu.**	**63.3**	52	Silver (Argentum)	Ag.	108
18	Didymium	Di.	147	**53**	**Sodium (Natrium)**	**Na.**	**23**
19	Erbium	Er.	166.3	54	Strontium	Sr.	87.5
20	Fluorine	F. or Fl.	19	**55**	**Sulphur**	**S.**	**32**
21	Gallium	G. or Ga.	69.9	56	Tantalum	Ta.	129
22	Germanium	Ge.	72.3	57	Tellurium	Te.	125
23	Gold (Aurum)	Au.	197.2	58	Thallium	Tl.	204.1
24	**Hydrogen**	**H.**	**1**	59	Thorium	Th.	232.4
25	Indium	In.	113.7	60	Thulium	Tu.	170.7
26	Iodine	I.	126.9	**61**	**Tin (Stannum)**	**Sn.**	**118.1**
27	Iridium	Ir.	193.2	62	Titanium	Ti.	48.1
28	**Iron (Ferrum)**	**Fe.**	**56**	63	**Tungsten (Wolfram)**	**W.**	184
29	Lanthanum	La.	138.5	64	Uranium	U.	239.4
30	Lead (Plumbum)	Pb.	206.9	65	Vanadium	V.	51.2
31	Lithium	Li.	7	66	Ytterbium	Yb.	173.2
32	Magnesium	Mg.	24	67	Yttrium	Y.	88.7
33	Manganese	Mn.	55	68	Zinc	Zn.	65
34	Mercury (Hydrargyrum)	Hg.	200.4	69	Zirconium	Zr.	90.7
35	Molybdenum	Mo.	95.9				

FINISHING PROCESSES AND MACHINERY.

FINISHING WOOLENS AND WORSTEDS.

The finishing of Woolens and Worsteds may conveniently be divided into Wet and Dry Finishing, and of which the first comprises all the processes from the loom to and including the dryer, the remaining processes belonging to the dry finishing department of the mill.

Wet Finishing comprises: Inspecting, Burling and Mending, Tacking, Fulling, Washing, Burr Dyeing, Carbonizing, Steaming and Stretching or Boiling and Stretching, Wet Gigging or Napping, Steam Lustring, Drying.

Dry Finishing comprises: Dry Gigging or Napping, Shearing or Singeing, Brushing, Polishing, Sanding, Steam Brushing, Spraying, Measuring, Doubling, Rolling and Weighing.

It must be understood however, that not every fabric is subjected to all the processes quoted, they simply being given as sub-divisions of finishing, to some of which a fabric in question may have to be subjected.

INSPECTING.

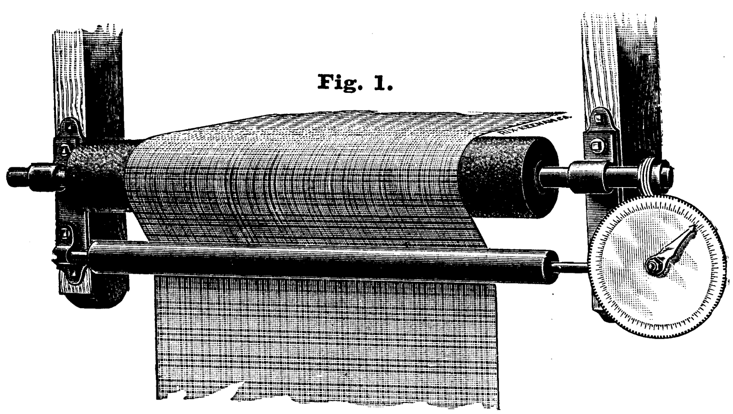
Although fabrics receive a perching, *i. e.* inspecting and measuring at the weave room, before they leave for the finishing room, yet said examination is, as a rule, not sufficiently reliable to have the finisher shoulder responsibilities, the same being more or less only performed for keeping the wage list of the weavers (find's) correct, or detect as quickly as possible imperfections in fabrics requiring at once prompt attention at the loom. In some mills a "sewing-in" department is connected with the weave room, whereas in others not, in the latter case the time required for correcting weavers' mistakes (find's) being then in turn charged by the finishing department against the fabric in question, *i. e.* the weave room and in turn against the weaver.

'It will be advisable for every finisher to have each and every piece of fabric inspected by a responsible percher under his charge. As will be readily understood, a good light (a good N. E. light in connection with large, clean windows) is the most important requisite for the inspector to do this work, the other being a perch over which the fabrics are examined, and which consists of two rolls, usually attached to wooden hangers, fastened to the ceiling, or they may be put on posts in the room; in either case in such a manner as to bring the fabrics, when pulled over the perch, squarely in front of the window. In connection with 6/4 goods two persons as a rule attend to the perching, the inspector standing on one side and his assistant on the other side in front of the fabric to be examined, pulling the fabric slowly over the perch, both persons at the same time examining the fabric carefully as to imperfections. These may either be caused by carelessness of the weaver, imperfect running of the loom, poor yarn, etc.; however, no matter what was the cause, it is the work of the inspector to detect these mistakes which require later on fixing in the fabric, and when found, mark them prominently with chalk for the purpose of calling the attention of the sewing-in girls to such places, whose work it is to darn and fix up such places, giving to them also in connection with bad cases directions how to remedy them.

The aim of the inspector should be to bring the goods out as nearly perfect as possible, and at the same time to have as few allowances as can be had. When the face of a fabric has been examined, the same is done with its back. In some instances, in connection with light weight fabrics, the latter are examined from behind the goods, the inspector or more often his assistant, for this purpose changing his position by stepping in between the two runs of the cloth, which thus brings one of the runs of the fabric between him and the light, in turn enabling him to look through the fabric, and consequently readily detect any imperfection.

Fig. 1 shows in its perspective view such a cloth perch, having also a measuring dial attached, for registering the length of the fabric perched; the circumference of the large roller *i. e.* the measuring roller, being the ratio between the dial, worm gear and its circumference. The hand on the dial is held by a nut and spring and at the end of each piece of cloth perched, may be easily turned back to zero by the fingers, without changing any screw or nut. The dial which is nickel plated, and usually made to register sixty yards, is generally placed on the right hand side of the perch. It will be readily understood that the length of the rollers used, depends upon the width of the cloth (from loom) made by the mill, the perch being built to suit. It also will be readily understood that in connection with narrow fabrics, *i. e.* 3/4 goods, one man alone can do the work.

Fig. 1.



When the inspector has thus carefully examined the fabric, and marked all imperfections, the piece is then rolled up and placed on a pile from which in time, it passes to the burling process.

BURLING.

The burlers, who are girls, and who usually work in connection with 6/4 goods, in pairs, together on a table, take the piece, and carrying it to their table, there unroll it and commence to examine the fabric, with its back up, for such imperfections as knots, bunches, runners, etc., using for this purpose both their eyes as well as their fingers, and in fact the latter more particularly.

The tables used for burling must be smooth, so that the burlers, when feeling for the knots or bunches, etc., will not come in contact with obstructions on the surface of the table, a feature which in turn would only create a loss of time, and in turn give rise to carelessness on the part of the girls by getting fooled.

The burling table should have its top fastened by hinges on one side to the framing, thus permitting the tipping of the top to any angle to suit the size of the girls; the top being held in this proper angle by suitable movable braces, placed on both sides of the table. This also permits the top to be let down level when the piece is finished, the girls then folding the fabric on the top of the table before taking it away. In some mills (although a question if advisable) the tops of the tables are covered with zinc so that a perfectly smooth surface is obtained. In this case however, care must be exercised that this covering, when wearing out, is promptly repaired, or the entire top re-covered to prevent damage to the cloth as thus burled over it.

The same as with any other hand operation, the use of the proper tool is of the greatest importance, and which tool in the present instance is the burling iron, which for this purpose should be ground flat on the sides and come to a sharp point, since if the sides are ground flat, the edges thus given the iron, will cut the threads easily and this with as little strain as possible on the threads; hence these irons should never be allowed to become worn on their edges, and neither as to point. Besides proper burling irons, a good pair of scissors are also needed by each girl, they to use them when cutting off knots, which never should be pulled off since by this procedure the respective threads in the fabric would become unduly tightened, and when released crawl back in the structure of the fabric, leaving an imperfection, *i. e.* a space without a thread, and consequently a chance for an imperfection to show in the finished fabric.

All the knots which have been tied in the threads during winding, dressing, beaming, weaving, must be looked and felt for during burling, and carefully drawn by the girls to the surface and then clipped off, leaving the ends long enough so that no space without a thread will occur. Threads which are found loose on the face or back, caused by the weaver having tied in a broken end, should be cut off and not pulled off, especially so if the thread in question has been interlacing tightly; however, threads interlacing loosely should be pulled to their proper position first. A bunch must be drawn out a little at a time so as not to disturb or strain the thread to which it adhered, neither the surrounding threads. The same care must be exercised with runners, as caused by the filling having been drawn, for more or less space at the selvage, into the fabric.

After the back of the piece has thus been carefully burled, the face is next taken in hand by the burlers. Here the removal of knots is attended to with more danger than on the back, it being usually sufficient to draw the knots to the surface and leave them there for the shear to clip them off. Bunches in the yarn and runners of the filling will also require considerable attention on the part of the girls, in removing them carefully so no harm to the fabric is done. All places where runners have been taken out should be marked so that the sewing-in girl later on can examine such places to see if it has been done in such a manner as to cause no damage to the joining picks. In other words each knot or other imperfection is removed either from back or face, wherever most prominent or the easiest to get at it, when dealing with single cloth structures; whereas in connection with double cloth fabrics, the place, *i. e.* whether face or back, is properly defined by the ply of the fabric in which the imperfection is located, as will be readily understood from the construction of these fabrics. After the piece has been thus burled, the same is folded and placed on a pile in connection with other fabrics previously similarly burled, and from where, in time, it is then removed for the next operation of

DARNING OR MENDING,

or also called sewing-in, which as a rule is only done by experienced girls or women in that work, in fact the person must be, what we may consider, an expert with the needle, in order to do perfect work. The object of darning is to bring the goods up to perfection before they are allowed to undergo finishing. It is a good plan, where sufficient room is at disposal, to give each sewer-in the use of a perch for doing her work, since this will facilitate perfect work, again if the person knows weaving, such knowledge will also benefit her in her labor. On "fancy" work it is essential that the sewer-in should understand the colors as used for producing the various effects in the fabric and have a good eye for imitating the latter, taking adjoining patterns for reference, both as to the interlacing of the threads as well as the coloring, thereby making a nearly perfect affair of some of the most imperfect places, certainly work which requires experience as well as attention. On plain or mixes, the weave alone will only come under consideration, all kinds of sewing-in being then more or less regulated by the kind of final finish of the fabric; thus indicating that more exact work is required for a threadbare fancy fabric, requiring little, if any, finishing afterwards, than if dealing with a face finish fabric and where gigging, *i. e.* the nap thus raised on the face of the fabric, will cover many imperfections, never to be noticed in the finished fabric. The work however is tedious in the extreme and trying to the eyes, however experience comes to the aid of the person and after awhile imperfections are corrected to a nicety which formerly appeared hard or impossible to be remedied. It will be also a good plan for the overseer to regulate the work, giving the hardest styles to be mended to the most experienced hands.

With reference to some kinds of plain, face finished fabrics, the cutting out of good picks, in place of sewing-in a missed pick, is frequently resorted to, for the fact that the sewing-in of mispicks is generally found to be too tedious. To do this cutting out of a good pick in order to remedy a mispick requires a knowledge of cloth construction (weave formation) in order to know which picks have to be cut and which not, and unless this is well understood by the sewer-in, it is best not to attempt it, in fact it is no use for the sewer-in to attempt anything in the line of darning unless it can be made to look, in the finished fabric, sufficiently perfect that an allowance need not be made, otherwise the whole labor spent in mending the imperfection has been lost time, and consequent waste in money to the mill. Never attempt to do the impossible.

After the piece of cloth is mended, *i. e.* all mistakes possible to be corrected attended to, the same is folded and put on a pile with other fabrics previously treated in the same manner, to lie there until required for the fulling mill or washer as the case may be.

TACKING.

The Tacking of woolen fabrics for the fulling process means the stitching or tacking of the two selvages, face inside, either by hand or machine, and is practiced for two reasons:

First. It has been practiced since the last forty years with fabrics requiring flocking, in this manner keeping the flocks off from the face, most of which during the process of finishing the face would only be lost again; at the same time introducing flocks onto the face of the goods would vary the shade of the individual pieces, since the color of the flocks varies constantly, thus making it hard, if not impossible to match the goods for filling a case.

Second. Woolen manufacturers however have since then found by experience that in connection with fine face goods which have to run in the fulling mill for some time, tacking them, will protect the face of the goods from chafing during the fulling, the face is kept from being worn by contact with the heavy rolls, and anything that will protect the face of the fabric in this manner, cannot help but have a beneficial effect upon the general appearance of it in its final finished state. At the same time, the selvages are prevented from rolling or curling over, or from being caught and torn in the fulling mills, and light and delicate colors cannot be affected in exposed places by strong soaps; many stains, caused either by uneven distribution of soap, or such which would otherwise get on the goods during the fulling or washing, are avoided, and the goods are preserved in such good condition that it helps greatly in all the after-finishing processes. The matter of thus preventing the selvages from rolling or curling by means of tacking them, allows the combination of uneven weaves to be used more extensively in the construction of fabrics than would otherwise be practicable. If goods on which the filling is thrown more on the face than on the back, or vice versa, are not tacked, there is in most cases, more or less bother in fulling and the after-finishing processes. Another advantage of tacking is found in connection with piece dye fabrics, and there the tacking, besides being beneficial to fulling and scouring, at the same time is of immense advantage to get even dyeing, *i. e.* the goods taking the dye the same on the sides as in the middle of the fabric, and not to "shade-off," one of the hardest problems to overcome in connection with piece dyes. When woolens are run in the fulling mills or washers, after being tacked, the air inside the goods causes the folds to change position each time as they pass between the rolls, thus avoiding fixed creases or wrinkles and the consequent streaking of the goods. In addition to this, the goods will full much more evenly when tacked, than if not tacked, since when the goods are run in tubular form in the fulling mills, there is no opportunity for the sides to flop around loose in the mills and thus be more exposed to the air, receiving less pressure and heat than the middle, and in consequence not full as much as in the middle.

Tacking is also practiced in connection with worsteds, for washing, fulling or dyeing purposes, either one or all these processes being done more evenly if the goods are run in tubular form.

Tacking originally was done by hand, and in some mills this may yet be done, however, the proper way to do it, is by means of a sewing machine constructed especially for this work.

Tacking by hand has been and is generally done by boys, who, as will be readily understood, have to be watched closely in order that they do their work right. There are two ways of stitching the selvages, viz.: either take a stitch through the lists every three or four inches, using a continuous string of twine for this purpose, pieced out as the boy proceeds with his work, or run needle and thread simply through the two selvages and tie the string in a knot, cutting off the string and repeat the affair every three or four inches. By the latter method there will be less chance for the loops of the twine to catch in the fulling mill, besides quite a saving in twine will be made, while the work will be quite as effective, if not more so, than in the first mentioned case, for if the loops of the continuous end of twine should catch on a projection in the fulling mill, the twine will break and release quite a number of stitches, thus leaving the face of the fabric more or less exposed, the same as if the goods were not tacked at all.

The advantage of tacking by a sewing machine in place of tacking by hand, is that the stitches thus made are of uniform size, and at the same time small enough to answer the purpose excellently. A long chain stitch about ⅞" long answers nicely for practically all classes of fabrics and it is not necessary to adjust the length of the stitch to each different fabric. The ordinary short stitches made on ordinary sewing machines which are not coarser than 4 or 5 to the inch, are not long enough for tacking goods which are fulled to any considerable extent. Short stitches of this kind will oftentimes cause the selvages to be severed from the body of the goods in the fulling process, or at best will felt in so tight that it will be impossible to pull the thread out. Short stitches will sometimes answer for worsted goods or some kinds of woolen goods which are fulled but little, but for the general purposes of tacking, a long chain stitch about ⅞" long, has proved the best adapted of any stitches we know of. If any goods need to be stitched more open than this, the operator can easily leave open spaces at intervals by running the stitches outside the edge of the goods. This regular stitch prevents the thread from fulling in too tight; does not allow flocks to enter; allows enough air to escape to prevent the goods from ballooning up too much in fulling, but retains enough to cause the goods to change position each time they pass between the rolls.

There are two different types of sewing machines built for this purpose.

The one style of machine, and of which a perspective view is given in Fig. 2, showing the machine as built by the Curtis & Marble Machine Co., doubles

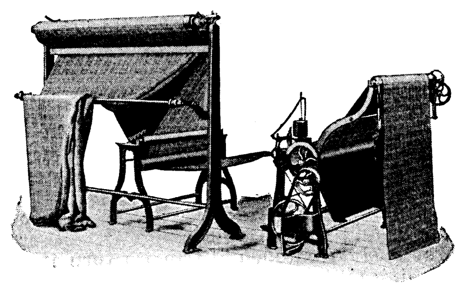


Fig. 2.

the fabric, and, after sewing the selvages together, folds the fabric in a pile, so that all the operative has to do, is to wrap the end around the piece, and place it in the pile with previously tacked pieces, ready for the fulling mill. The doubling in this machine is accomplished by pulling the fabric over a frame which stands upright about six feet, and has a roll at the top, over which the cloth is drawn. A friction attachment is supplied to this roll, in order to put tension onto the fabric and thus bring its two sides evenly together. An adjustable V-shaped or triangular frame runs slantingly from below this top roll to a point about 40 inches from this frame, and to about the same height from the floor as the sewing machine attachment. The end of the fabric is then pulled down and its two sides placed together below the triangular frame, previously referred to, and in turn brought forward, and into the action of a pair of feed rolls of the machine. The sewing is not started till about a yard of the fabric has been pulled through, and then the selvages are brought under the needle and stitched. The cloth then passes over a draft roll situated above the folder, and which takes the fabric from the sewing machine as fast as sewed and delivers it into the folder, which in turn folds it off nicely behind the sewing machine. An adjustable guide is provided to aid the operator in guiding the cloth under the needle straight and even, and this guide can be adjusted so as to stitch as close to, or as far away from, the outer edge of the goods as desired. Although, as a rule, the goods are tacked in a dry state, we may mention that if so required, the machine will stitch them when in a wet condition. After the fulling and washing are completed, by loosening one end of the thread the stitches may be drawn out. The doubling frame is readily adjusted for running different widths of goods, so as to always bring the selvages in line with the sewing mechanism. The operator controls the running of the machine by means of a foot treadle operating through a friction clutch. The standard sizes of these tacking machines are built for 72″, 80″, 90″ and 100″ wide fabrics from loom, wider or narrower machines however being built to order.

The other style of sewing machine previously referred to for automatically tacking, *i. e.* sewing the two selvages together is constructed minus the doubling and folding attachment for the fabric, but which machine, with a little care on the part of the operator, can be made also to do good work. Its principle of construction is identical to that of the common mill sewing machine, as used for sewing the ends of pieces together, when the fabric is threaded in a gig, napper, shear, etc., with the exception that the ring which acts as a feeder is extended into a drum, of the width of a doubled piece of cloth. This drum contains pins to hold the cloth in position and also a guide for the edge of the selvages, so that when the latter comes in contact with this guide, as the goods are fed to the drum and sewing machine, the sewing is sure to be done in the centre of the selvages. In order to operate this style of a sewing machine to its best advantage, be sure that the piece of cloth to be tacked is laid down back of the operator, in line with the needle bar of the machine, and this as far back as space will allow. This arrangement will bring the two selvages on a line and in turn save the operator much pulling, in fact, will permit him to double the fabric, ready for sewing, as fast as the machine can handle it.

After the fabric has been tacked, roll it into a compact bundle, and place it on the pile with other pieces, thus previously treated, until in its turn it is taken to the fulling mill.

FULLING.

The purpose of fulling is to obtain the shrinkage required for the proper length, width and weight of the fabric, at the same time putting the structure in such a condition as to permit the successively following finishing processes to be properly performed; it adds strength to the fabric; loosens any superfluous dyestuff matter adhering to the fibres, as well as all oil, grease, etc., added to the wool to permit carding and spinning, size added to the warp yarn for proper weaving, etc. This loss in weight of the fabric, as well as any further loss to the cloth during scouring, gigging, napping, shearing or any other finishing process, must be carefully taken in consideration by the finisher, with reference to shrinking length of fabric, in order to obtain proper final weight of cloth required.

Fulling is based upon the felting properties of the wool fibres, as explained on pages 31 and 32, a study of which will greatly assist in a clearer understanding of the principle underlying this process. The felting capacity of the wool fibre is, during fulling, called into action by bringing an alternating pressure to bear upon the moist fabric, *i. e.* wool fibres, in connection with a certain amount of heat. This alternating pressure is produced in the fulling mill by means of a set of rolls, between which the cloth is made to pass. These rolls vary in size in the various makes of fulling mills, however about 8″ face $\times$ 18″ dia. is a fair average of their dimensions. The face of the rolls is generally of wood or hard rubber, while the rest is of iron, very few all iron rolls being used. In most makes of fulling mills smooth face rolls are used, however in some makes the lower one of these rolls is supplied with flanges and the upper roll made to run inside of them, again in some foreign makes of machines, the shape of these rolls is changed (this subject is explained in a special article later on). As the weight of the top roll is insufficient to exert sufficient pressure upon the cloth under operation, elliptic springs are used to increase this pressure. The aim of the fuller should be to put as much cloth as possible between these rolls, since this will act as a cushion, and the pressure will thus be more effective. To keep the cloth running in the proper position in the mill, guide rolls and a guide frame are placed in the mill, the latter in some instances being made to act as a stop motion, provided the run of the cloth gets, for one reason or the other, snarled up at the bottom of the mill, and thus causes a knot to form, which on account of being too large to pass through its guide ring in the frame, will lift the whole frame and thus cause an outside arm, through proper lever connections to stop the machine, in turn preventing the cloth from being worn tender in places, or causing holes to be made, as would be the case if the run of the cloth was arrested, and the rolls keeping on turning, and consequently acting continually on one place of the fabric.

The pressure thus exerted by the rolls upon the fabric is, however, only in one direction, and which is laterally, for which reason the fabric if only exposed to this pressure, would shrink only widthways, the strain put upon the fabric while being pulled along by the rolls, through guide rings and from the bottom of the mill, having a tendency to rather stretch the fabric lengthways than shrink it. Thus means had to be provided in the construction of the fulling mill to counteract this tendency, and simultaneously exert sufficient pressure to cause the fabric to also shrink in its length when so required, and what is accomplished by providing a device known as the trap or clapper to the mill. This contrivance is placed directly back of the rolls, and in such a position that the fabric will have to pass through this box-like affair before allowed to drop to the bottom of the mill. These boxes vary in length in the different makes of fulling mills, however, they should not be allowed to fall below 18 inches in length. The top of the trap is firmly fastened to a shaft, which extends to the outside of the fulling mill, and is also supplied with an arm, which is fastened so as to stand in the same direction as the top of the box, which is fastened to the other end of this shaft. This cover is made to fit inside of the box, being of a shape to permit its easy working up or down. To the end of the outside arm is fixed a rod, which hangs down, being arranged to allow weights to be attached to it. The pressure required to lift the top of the box must thus be strong enough to also lift this arm with whatever weights are attached to it, and by this means the pressure is brought to bear upon the fabric. At the same time, by means of changing the weights, the pressure required is regulated. The goods, after being pushed into the box by the rolls, accumulate until the pressure is sufficient to raise the top of the box, and thus allow the goods to drop again to the bottom of the mill, the goods being thus shrunk in length according to requirements.

Again there is another class of goods, where instead of shrinking the goods in their length, they are required to stretch a certain amount, making them come from the fulling mill rather longer than when they entered it, flocks in many instances being relied upon to bring them up to a required weight.

Different pieces ought to be sorted, because every different structure of cloth will full differently, and if two pieces of a different construction are put into the mill together, one will come up quicker than the other, leaving one running alone, causing it to full slower, run longer, and in turn become weaker than if run with one of the same style.

The moisture required for felting is added to the fabric in connection with a good soap, which in turn also exerts a softening influence upon the fibre, besides being useful in removing the emulsion which has been given to the wool stock in the picking room in order to be able to card the wool and spin the roving into yarn. Again it will keep the goods from chafing and wearing off too much during the fulling process. The requirement for a good fulling soap is a hard soap, which is free from caustic, *i. e.* is neutral, for caustic, if present to any extent in the hard soap, is sure to injure the colors more or less, if not the fibre, and once the color has been injured, it is impossible to remedy the injury. The strength of this soap for fulling purposes depends upon the fabric handled, the same however must possess sufficient body to turn out the grease from the fabric, and hold it in such a state that, to all appearance, it might be scraped off the cloth any time, to the end of the process. If the soap is not heavy or has not sufficient alkali to start the grease, dirt, etc., in the cloth, cloudiness and dullness of colors are sure to result. For fabrics with extra bright colors, and which naturally have been more carefully handled from the fibre to the woven cloth (cleaner all around), use a good neutral soap liquor, lukewarm, pour slowly on the fabric, not too much at a time, the weight of the goods determining this point, using about one pound hard neutral soap to a gallon of water, and about 9 gallons of this prepared soap liquor to about 45 lbs. of goods. In solid colors, as mentioned before, a very small quantity of alkali might be used, if any difficulty found in forcing out the grease, dirt, etc. Some claim that alkali assists fulling, but the proper way is to only help to loosen the grease and dirt by means of it, the fulling not to commence until the grease and dirt in the fabric become loose. One pound of good soap used in this manner will do more towards getting the goods clean than double or more the amount used later on in the washing machine, by preventing the dirt from being first felted into the cloth structure, making it hard to get rid of in washing afterwards. Thin alkali soaps, if used, will run the dirty grease and dyestuffs through and through the fabric, staining the structure and causing the colors to become dead. There will be found a vast difference in the finished fabric between starting the fulling in a greasy condition or when this grease has been loosened, this being the reason why very delicate fabrics are first washed before brought to the fulling mill. Heavy goods and fabrics constructed with an extra high, heavy texture, and such as carry in their body a considerable amount of grease and dirt, will frequently be found to full with difficulty, for which reason, it is well to also wash such fabrics previously to fulling. This washing does not necessarily have to be as thorough as that which succeeds the fulling, however it has to be sufficiently vigorous to loosen up the foreign materials in the fabric, and give the fibres an opportunity to come in contact with the soap during fulling, and thus to get all the benefit which is to be derived from moisture, heat and friction.

It might be thought that washing the goods before fulling would make the latter operation, so far as time is concerned, shorter, but this is not so, however, the distinct advantage comes in the appearance of the finished goods, together with their handle or feel, and brighter colors obtained, all of which should repay the extra expense of a first washing of such fabrics. This previous washing will also aid when dealing with fabrics in the construction of which low grades of carbonized wools have been employed, and when there is a considerable difference in the amount of time required for fulling these goods when they are washed previously, and when they are not. If they have been thoroughly washed for three or four hours with a good supply of soda alkali, previous to fulling, the time required for the latter operation will be reduced nearly one-third. Again if shoddy is extensively used, as it generally is in these low grade woolens, then the washing before fulling will in many instances give the fabric the appearance of all wool cloth, pretty nearly covering the adulterant, however, the shoddy in this instance has got to be in the right condition, that is, if it is carbonized, as it usually is, it must be washed free of sulphuric acid, since where this free acid is present, and the goods are brought in contact with a soda alkali, the tendency is for the formation of a combination upon the surface of the fibres, which will act injuriously in connection with the fulling, since it is insoluble in water unless the water is considerably heated.

The water as used in preparing the soft soap for fulling (and consequently also for scouring purposes) must be also taken into consideration, since if said water contains lime, salts of magnesia, etc., it will decompose the soap, and consequently interfere with the fulling as well as the cleansing of the goods thus treated. It is thus a very important point to determine the quality of the water to be used in preparing the fulling liquor, or to be added to the fabric if so required, so that the proper source of any trouble in further departments of the finishing room is properly accounted for. To commence with, if the fulling liquor is made up of hard water, as mentioned before, the soap in this instance is rendered partly useless. Some finishers may claim that the excess of soap, always given for a bath, will counteract the effect, but this is a mistake, not only on account of the loss of soap, but also that what is left is lime soap, which is of little or no use. Such soap during fulling (as well as scouring) will continually separate, and the cloth will, despite all efforts, have a harsh, raspy, dry feel. Examining the cloth during or after fulling will show no soap froth, but in place of it a thin, weak lye; again soap has to be continually added, and even with this expensive remedy, the cloth will continue dry. After fulling then comes the difficulty of trying to remove these additions by excessive washings, and finally the result, a hard boardy fabric, too smooth to the feel or touch of the hand. The more fat there is used in the manufacture of the soap, the worse is the effect of hard water. Water only slightly hard, may be softened by boiling, whereas very hard water, provided it is the only one at our disposal, may be softened by boiling, provided bran is added and which then is removed before using. Wyandotte textile soda is an excellent medium for preparing hard water for fulling and scouring purposes.

In dealing with a fabric requiring gigging or napping, the influence of using a hard water is everlasting, for if the wool fibre is rendered hard by the water, the felt cannot be easily loosened on the gig or napper, nor can it, under any amount of work, be made as open and soft as it ought to be, or as it would be provided soft water had been used. If such a case occurred, the only way to remedy the trouble somewhat, is a free use of moderately warm condensed water. Soft water will even harden the goods if they are allowed to remain any length of time in a wet condition, and naturally hard water, under the same conditions, will aggravate this trouble. This explains why any piece of cloth if gigged or napped at once after fulling and scouring, can be handled easier, quicker, and will be more effective than if the fabric is allowed to lay in a wet condition for hours, or possibly for days. Now if this is the case when using a soft water, how much worse would it be if using a hard water. For this reason it must be remembered that the fulling of fabrics should under no circumstances be too far in advance of the gigging or napping process—both must go hand in hand for good results in the finished goods—and if for any reason the napping or gigging department falls behind the fulling department to any extent with their work, then the goods, after scouring, are better dried temporarily, especially when dealing with fabrics calling finally for a soft, pliable, velvety finish.

After the goods have been soaped in the fulling mill, and allowed to run long enough for the soap to spread and evenly wet the goods, the time for their first examination has arrived. The goods running in the mill should be examined at stated periods to see if they come up even both ways, for if lacking in either respect, this must be attended to at once. If the goods do not come up in length as fast as they should, more weight must be applied to the trap, but if the supply should be exhausted, as will sometimes happen, then the pressure of the roll must be lessened, and in this way the shrinking sideways retarded so that the goods may have a chance to come up lengthwise by the time they have sufficiently shrunk sideways. After thus examining the goods, it is a good plan for the fuller to scrape off, more or less, any soap which has spattered on the sides and other parts inside of the fulling mill, and put such soap back on the goods, thus not only keeping the inside of the mill in a better condition, but at the same time use the soap to its full value. Soap if deposited in quantities and for time on the metal parts of the machine tends to corrode them, and if left on them to dry, will form a hard scum which in time will become detached and fall on the goods, and in passing through the rolls is apt to do damage, however slight it may be. The accumulation of soap on the wooden parts of the machine will exert a tendency to warp them more or less, a feature readily seen when the doors of the machine will shut hard, hinges rust off, etc.

If goods are flocked, all the flocks and waste matter coming from the mill must be taken care of, *i. e.* away from the machine—to wherever they belong.

The sewing together of the ends of the fabric or fabrics, after they are put into the mill must be carefully done, making the seam firm and smooth, whether made by hand or by machine. In connection with hand stitches, take small and even stitches, whereas in connection with machine seams, see that the seam is not made too deep into the cloth and thus bulky, in turn creating a pounding each time such a seam passes between the rolls. Have the protruding ends of the seam turned inside, for this will greatly help its smoothness.

Pressure in a fulling mill for shrinking the fabric either way must be put on easy and a little at a time; this will be found far better than putting on full pressure at once, for the fact that if shrinking the cloth too suddenly, good felting is lost sight of. By taking this precaution, the goods, when finished, will not look starved, nor handle hard and wiry. If the goods shrink too slow in width, a little additional pressure put onto the top roll, will help, the same as additional weights on the trap will help to shrink the fabric in its length, and vice versa in both instances.

Provided fabrics come up continually too fast in their length, it is a good plan to somewhat draw down the rods of the elliptic springs, and thus increase the pressure of the rolls. But if this does not help, then the best plan is to double such pieces in the mill, thus increasing the volume of cloth at one time under the influence of the rolls (more pressure exerted) and at the same time shortening the piece by one-half, and when consequently the goods will be under the roll oftener than if they were single.

On light weights, two (or three) pieces side by side are generally run in the mill, in this way not only increasing the production, but at the same time the goods will run better all around.

If goods are fulling too long, take them out and reverse the ends in the mill, and when they have run about half time, shake them out thoroughly from end to end.

Heat is an agent necessary to the felting of the wool fibre, however care must be taken to avoid too high a temperature during fulling, since such would seriously injure the colors—about 85° F. is a good average, possibly 90° F. as a limit—again there are some classes of colors very sensitive to heat, and which consequently must be treated at a lower temperature according to fastness of color to fulling. Heat influences moisture, and consequently as the fabric gets warm in the mill, a good deal of the moisture then in or on the fabric will evaporate, and since it will not do to let the cloth run too dry, *i. e.* short of soap (since then goods will chafe, resulting in a loss in weight, creating more flocks — neither will the fabric thus fulled, gig or shear clean and clear) the fuller, as soon as he sees that the pieces are not as wet as they should be, must at once add a little more soap, however, remembering that it will not take much to bring them again to their proper moisture. If it should occur, either through carelessness or otherwise, that too much soap has been applied to the fabric, then the best remedy is to run at once, and quickly, a dry fabric in the mill, and which at once will absorb any surplus of soap from the fabric under operation, though it must be clearly understood that without sufficient soap and heat, goods will not felt—shrinking may be got without felting, but this is not proper fulling.

As soon as the fabric is up in its width and length, the fuller must test the soap in the fabric, and in every piece provided two or more fulled at one time, to see if it has turned watery or not. When the pieces are handled, and a gentle squeeze given, a little free soap should appear; this is a test that sufficient soap has been used, or that the soap has not lost its vitality by too long fulling. This test should not be omitted, since it will save trouble. In any case where the soap does not show up as thus mentioned, give the pieces an additional dipperful of soap before taking them from the mill, which will then help them in the washer.

When the fabrics are then taken out of the mill, remove the tacking strings, provided the goods had been tacked, after which, except they can go at once in the washer, open them out so that the air can get at all parts of the fabric, since they are then warm and if left lying in piles would start the colors and thus dullen them. Such an airing, in connection with goods to be piece dyed, will also prevent the formation of streaky and cloudy places in such fabrics.

The general construction of

A Rotary Fulling Mill is shown in Fig. 3, the same being a side elevation of the machine as built by the James Hunter Machine Co., having what is known as the Ryan Stop Motion applied thereto. This stop motion is used on fulling mills, where low grade or hard fulling woolen fabrics are treated, and in which case the work is facilitated by running the goods under operation, in double "runs," side by side, through the squeeze rolls of said fulling mill. When the cloth is run in this manner, one run is very apt to gain on the other, resulting, in one of the runs, in the formation of a short loop, as distinguished from the long or loose loop as should be the case in both runs. This short run will soon stop the progress of the cloth in the fulling mill, but as the latter continues in its motion, the rolls of the machine will soon wear out or burn the cloth, in places where

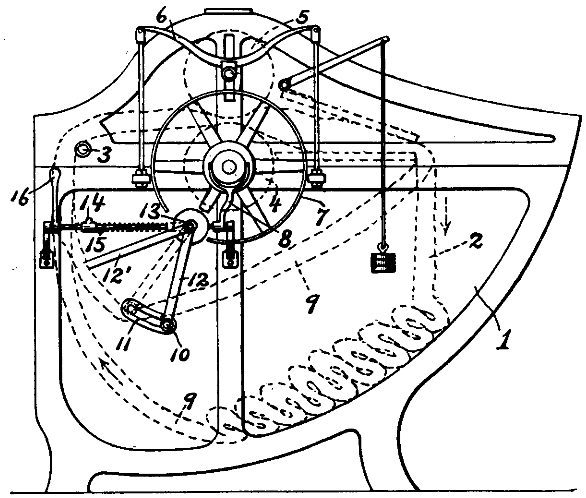


Fig. 3.

said rolls come in contact with the cloth, a feature which of course spoils the goods.

The object of the stop motion, therefore, is to automatically stop the fulling mill when such a short loop is about forming itself in one of the runs of the fabric and thus prevent damage to the goods, the stop motion acting before the loop in question becomes sufficiently short.

Referring to the illustration, 1 indicates the casing of a fulling mill, in which the cloth 2 travels during the operation of fulling, in the direction of the arrows. As the cloth comes up from the bottom or floor of the mill, it then passes over guide roll 3 to and between the squeeze rolls 4 and 5, the latter being in frictional contact with roll 4 by means of the elliptical springs 6 (one on each side of the machine). Roll 4 is positively driven from a pulley 7 when the latter has a clutch 8 thrown in with it.

The runs of cloth pass between these two squeeze rolls 4 and 5, side by side, and it often happens, from one cause or another, that one run will gain on the other in passing through the machine, which in time causes a short loop, as indicated at 9, to form itself and if the latter continues to shorten, it would finally shorten said short loop of the cloth shown at 9 to such an extent as to stop the motion of the cloth, which then would remain idle, and in one place under the action of the squeeze rolls 4 and 5, which by revolving under pressure on one portion of the fabric for some time would then soon wear out or burn holes in said portion of the cloth.

The stop motion, to prevent these short loops from forming, is composed of a rod 10, extending across the width of the machine and having its end in slotted pieces 11, one on each side of the machine. Attached to the rod 10 is an elbow lever 12 and 12′ as pivoted at 13. When a short loop begins to form, it will soon become tight enough to press against the rod 10 and move it in the slotted pieces 11 into the position shown in dotted lines, thus giving movement to elbow lever 12, 12′, and cause its arm 12′ to move against an arm 14, fast to the shipper rod 15. This action gives a partial rotary movement to shipper rod 15, which will take the clutch 8 out of contact with the driving pulley 7 and thus stop the rotation of the fulling mill.

When the short loop is afterwards straightened out again by the fuller, tne elbow lever 12, 12′, will drop to its normal position.

The stopping of the machine, when so desired for any cause whatever for example examining condition or width of fabric, taking fabric out of the machine, etc., is done by means of handle lever 16 as also attached to the shipper rod 15, this being done without interfering with the stop motion arrangement previously described; handle lever 16 in turn being also used to again start the machine.

Another Stop Motion for a fulling mill (showing in this case another make of a fulling mill) is shown in Fig. 4, the same consisting in an automatic belt shifting mechanism for automatically stopping the operation of the mill when a knot or other obstruction passes between the squeeze rolls thereof. The illustration shows a front elevation of a part of a fulling mill, having this stop motion applied thereto.

The frame of the fulling mill consists of parallel standards 1, connected at their upper ends by a cross bar 2; 3 designates one of the squeeze rollers, supported in bearings of the frame standards, and above this roller 3 is located a lever 4, fulcrumed on a bracket 5, secured to the outer side of one of the brackets 1. The inner end of the lever 4 is supported in a loop 6, depending from the cross bar 2, of the frame, and upon the lever 4 is mounted the other squeeze roller 7, which is in normal condition during the running of the machine, parallel to the lower squeeze roller 3. The outer end of the lever 4 extends beyond the framework of the machine, and is connected pivotally to the upper end of a rod 8, the lower end of which is pivotally secured to one end of a latch bar 9, which is centrally pivoted to the

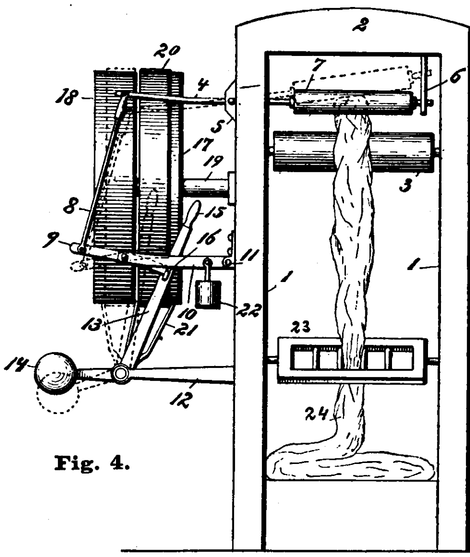


Fig. 4.

outer end of arm 10, the inner end of which is pivotally secured to bracket 11, projecting from the adjacent standard 1 of the machine.

Below the arm 10 a bracket arm 12 projects from the standard 1, and to the end of the arm 12 is fulcrumed a bell crank lever 13, the short arm of which has a weight 14 attached thereto. The long arm of the bell crank lever terminates in a handle 15, and below the handle a catch 16 projects from the lever in position to be engaged by the free end of the latch 9. This lug or catch 16 is of a length equal to the combined thickness of the bar 9 and arm 10, so that the latter will rest upon the lug after the latch bar 9 has been disengaged therefrom. 17 and 18 respectively designate the fast and loose pulley of the machine, and which are mounted on shaft 19. 20 indicates the driving belt and 21 a belt shifter fork, secured to the fulcrum point of the bell crank lever, its fingers being adapted to engage the edges of the belt to shift the latter from one of the pulleys to the other. Suspended from the pivoted arm 10 is a weight 22, which serves to hold the latch 9 in contact with the lug 16 of the shifting lever. 23 designates the guide, through which the cloth 24 passes from the bottom of the fulling mill to the squeeze rollers.

The operation of the mechanism is as follows: The cloth 24 passes from the guide 23 to the squeeze rollers 3 and 7 and from thence to the fulling mill proper for treatment. As long as no knots, kinks, or other obstructions are encountered during the run of the cloth in the fulling mill, the squeeze rollers 3 and 7 revolve and the parts of the mechanism retain the positions shown by the full lines in the illustration. If, however, the cloth contains a knot or kink, the passage of such obstruction between the rolls 3 and 7 will cause the lever 4 to tilt on its pivotal support 5, to the position shown in the dotted lines, thus depressing the connecting rod 8 and the outer end of the latch bar 9, thus disengaging the inner end of said latch bar from the lug 16. As soon as the latch bar 9 is disengaged, the weight 14 throws the shifting lever 10 outward, causing in turn the fork 21 to shift the belt 20 from the fast pulley to the loose pulley to stop the fulling mill. At the same time the arm 10 drops against the lug 16, which supports it until the parts are restored to their normal position. After the obstruction has been removed the parts are returned to their normal position and the operation of the fulling mill is resumed.

A description of the construction of

A Foreign Make of a Fulling Mill is shown by means of Figs. 5, 6 and 7; and of which Fig. 5 is an end view of this fulling mill, with the principal doors of the machine removed, in order to more clearly show its interior construction. Fig. 6 is a longitudinal sectional view of the machine, and Fig. 7 shows four different forms of squeeze rollers, having profiled working surfaces.

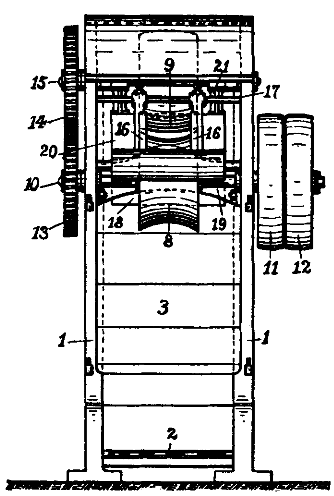


Fig. 5.

The frame of the machine consists chiefly of the two side parts 1, connected by the stay-rods 2, and is closed on the under side by the feather and tongued boards 3, fastened to the inner flanges of said side parts 1. The upper part of the machine is likewise closed in order to keep out dust and other impurities. Admission to the interior of the machine is gained at the front by means of a double door 4 and an upper door 5; and to the rear of the machine by means of horizontally swinging doors 6 and 7.

The efficiency of any fulling mill greatly depends upon the squeeze rollers 8 and 9, which in this make of machine have profiled surfaces, so arranged as to form a passage or passages between them deeper in cross section at their middle than at their ends. The one end of the shaft 10 of the lower squeeze roller 8 is provided with a tight pulley 11 and a loose pulley

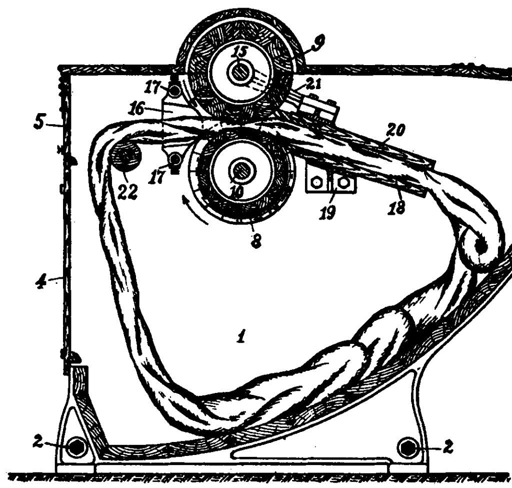


Fig. 6.

12, and the other end of said shaft 10 carries the wheel 13, meshing in turn with the wheel 14, seated upon the shaft 15 of the upper situated squeeze roller 9.

16 are two guide boards, adjustably seated upon the rods 17, placed in front of the squeeze rollers 8 and 9, while behind the latter is arranged the trap or clapper, consisting of the stationary bottom 18, carried by the bracket 19, and the swinging cover 20, attached by arms 21 to the shaft 15 of the upper profiled squeeze roller 9.

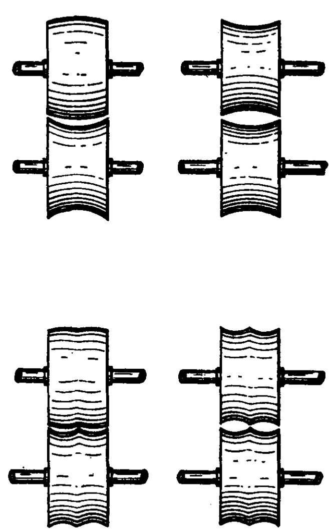


Fig. 7.

It will thus be seen that with the exception of the profiled squeeze rollers 8 and 9, this fulling mill is identical in its construction and operation with such as built here, the fabric (its end sewn together, in an endless string of cloth), after the machine is set in motion, being drawn by means of the friction of the coöperating squeeze rollers 8 and 9 through said rollers and in turn pressed into the trap or clapper 18, 20. On leaving the latter, the fabric drops to the bottom of the machine, and in turn is drawn up again over the small guide roller 22, in order to enter the squeeze rollers 8 and 9 anew. This cycle of operations comprises the operation of fulling and is continued until the fabric has been fulled to the degree desired.

Giving the squeeze rollers 8 and 9 profiled surfaces as shown (other similar shapes can be substituted) by means of the four diagrams in Fig. 7, is claimed to have for its purpose, *i. e.* advantage, to concentrate the cloth in the central part of said rollers, similar to a hank, so that it will full better in its width, the inventor of these profiled surface squeeze rollers (the most prominent builder of fulling mills in Germany) at the same time claiming that common cylindrical squeeze rollers will have a tendency to cause the fabric to broaden out toward the ends of the rollers, and which cannot take place with these new squeeze rollers, since the profiled working surface of these rollers concentrates the mass of the cloth under operation, more or less, in or toward the centre. The builder of these fulling mills further claims that the consequence of the marked concentration in the central part of the curved surface of the rollers is a more elastic and effective pressure of the upper squeeze roller on the cloth, and that this is another cause for the fabric fulling widthways more rapidly. Another advantage claimed for these profiled rollers is that they will cause the different layers of the fabric or fabrics under operation to slide one over another and thus cause the creases of the fabric to change their position as often as the fabric is passing between said rollers, owing to the different circumferential velocities of the working surfaces of these rollers. Still another advantage claimed for these rollers is that in consequence of the friction between the different parts of the fabric passing through the profiled rollers a better felting of the former is obtained.

The Hammer or Beater Fulling Mill. This is the original fulling mill, the Rotary Fulling Mill, as previously explained, and which is the fulling mill for woolen goods of to-day, being a more modern machine, having first come into use about the year 1820. This Hammer fulling mill, is at present chiefly used only in connection with fulling short length, all wool and woolen and cotton fabrics, such as shawls, blankets, underwear, knit goods, socks, etc., although in few special instances we may still meet with it in fulling heavily felted woolen goods.

The pressure to the fabric, necessary for felting the fibres by means of the hammer or beater fulling mill, can be obtained in two ways, viz.: such makes of machines in which the beaters, as hanging suspended from the frame work of the machine, are raised and lowered vertically by means of a roll having four projections on it, and which in turn engage projections on the beaters; or any similar arrangement for alternately raising or lowering said beaters may be used. There are two beaters used for each trough as holds the cloth under operation, said beaters working alternately, they being at their lower ends which come in contact with the cloth to be fulled step-shaped, at an angle of about 45°, and by means of which shape they impart to the fabric under operation a rolling motion, by means of which different portions of the fabric will continually come under direct operation of the beaters.

In the other construction of these kinds of fulling mills, the beaters are operated in a more or less horizontal direction (with a corresponding change of the trough) by means of suitable crank and lever connections; this latter style of a hammer or beater fulling mill having been illustrated and explained on pages 242 and 243 in the chapter on Knitting.

FLOCKING AND FLOCK CUTTING MACHINERY.

Flocks, if carefully handled, need not be a detriment to the fabric, although the latter, *i. e.* flocked goods, are always treated with more or less suspicion by the commission merchant and clothier, as well as by the consumer, possibly for the fact that flocks and the process of flocking the goods do not receive the care they should.

One of the disadvantages of flocked goods frequently met with, is the tendency of the flocks to drop out the fabric and gather in the lining of the garment; for this reason such garments as are lined, as coats, for example, have their lining loose at the bottom, so that whatever flocks work out of the fabric during wear, will drop out of the garment and not get a chance to lodge in the bottom seams of the lining. However, when flocks are thus coming excessively out of the fabric or garment (some certainly will always more or less come out), it is a sure sign of an error somewhere, either poor flocks, a wrong way of flocking, or more flocks used than is consistent with the structure of the fabric under operation, etc.

With reference to poor, *i. e.* low, cheap grades of flocks, one point is sure, and that is that these cheap grades of flocks are the most expensive in the end, since there is more waste in the first place, and in addition an excessive amount of these low grade flocks must be put on the goods to bring them anywhere near the weight wanted. Thus the necessity of using an excessive amount of flocks in order to bring the fabric under operation up to its required weight, will cause the flocks to get on the face of the goods, no matter how well they are tacked, and this, of course, lessens the attractiveness of the face of the goods. Flocks certainly are an adulterant to woolen fabrics, they are added with a view to get, in proportion, for this inferior article, the full value of the fabric, and as with all such adulterants, only the best should be used.

However, another important feature to be taken into consideration, besides the grade or quality of flocks at hand, is the structure of the fabric to be flocked, for the fact that flocks will not felt as readily to goods containing a considerable amount of shoddy, mungo, extract, waste or cotton, as to a fabric made of a good wool stock, where the wool fibres (may they be what we term wool or shoddy) have plenty of felting power. Some authorities quote: "Use good flocks with already adulterated structures, and poor flocks with pure wool structures." This may be all right provided a poor lot of flocks, by carelessness of the buyer is already in the mill, but to buy a poor grade of flocks for the sake of trying to save money to the mill, is a poor policy, the difference in price being too small an item and the cost of trying to use the poor flocks will certainly equal if not exceed the saving in the first cost of the flocks. At the same time let us mention that even with good grades of flocks in a mill, only the best can be used with lower grades of fabrics, for example, cotton warp goods, termed more generally union cassimeres, where the warp is mostly all cotton—with a fancy woolen thread possibly now and then introduced for a fancy effect—and where the filling is a mixture of a few per cent of wool, and any amount of per cent of shoddy, waste, mungo, or cotton. To try and stick a poor grade of flocks on such a structure can only result in failure, for in most cases a considerable amount of the flocks will sift out of the goods before they leave the mill, to say nothing of what happens afterwards during the manufacture of the clothing, and the wearing of the garment. There is nothing to retain the flocks, they have nothing in them to make them adhere to the structure on which they are simply pasted, and stay on while wet, but the moment the goods are dry, they drop off; whereas a flock which has felting qualities will be more apt to become part of the fabric, having more or less sufficient power within itself to do so.

This naturally leads us to the question of how to distinguish good flocks from poor flocks. In answer we must admit that it is a hard matter to determine the value of a lot of flocks until the same is tried, for even if the flocks have been made of good stock, it is possible for them to be spoiled in the process of cutting, and for this reason flock cutting machinery must be kept in good condition, for anything which will tend to grind instead of cutting the stock, *i. e.* the fibres, will at the same time destroy the felting properties of the flocks thus produced, the best of stock in this manner being frequently made practically worthless. Thus we see that the first and most important element in successful flocking is (1) the quality of the stock, and (2) the proper cutting of the same. This feature of a scientific cutting of the stock into flocks is readily seen by the value of what is known as shear flocks. These flocks are the clippings of the protruding ends of the nap obtained in shearing face finished goods or of protruding fibres of the threads in connection with threadbare finished fabrics; and since such flocks are cut most carefully at the process of shearing, they naturally retain all the felting capacity of the fibres.

The stock to be cut is of two kinds: (1) rags, which have to be first cut into small pieces on a rag cutter, previous to being submitted to the flock cutter, and (2) mill waste of every description, like gig flocks, sweepings, etc., which do not require handling by a rag cutter; however no matter what stock to be used, it must be first well cleaned of all such things as nails, pieces of metal, or any other hard substance, etc., before cutting, since otherwise the blades of the flock cutter would get ruined. This cleaning of flock stock is done by running the latter through a flock renovator, where the stock is not only opened and put in the best condition for cutting, but all foreign, heavy substances, as previously referred to, will fall to the bottom of the machine and not go through with the stock, and in turn spoil the blades of the flock cutter. This machine can also be used for blending and mixing several grades of stock, mixing up shades, as well as for thoroughly opening and dusting flocks which have become caked together in the bale from dampness, long standing or any other cause.

Of the accompanying illustrations, Fig. 8 represents the Curtis & Marble reversible rag cutter for preparing rag stock for cutting into flocks. This machine has blades about 15″ long made to work on the same principle as their flock cutter, of which an illustration and description is given later on. The blades in both the cylinder and the bed, are plated with steel on both edges, so that the cylinder may be run first in one direction and then in the other, the reversal of the motion of the cylinder rendering all the blades, in both cylinder and bed, self-sharpening. When one edge of the blades gets dull, the feed apron is taken off and put onto the other side of the machine, and the cylinder is then run in the opposite direction. The machine cuts the stock up into narrow strips or pieces about ⅜″ wide, leaving it in good condition for feeding into the flock cutter, and has a capacity of 2000 to 3000 lbs. a day, according to the kind of stock. The usual speed of the machine is from 250 to 300 revolutions a minute.

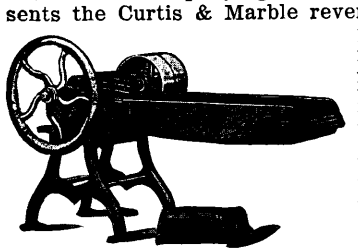


Fig. 8.

Fig. 9 is a perspective view of the flock renovator as built by Curtis & Marble, the object of which machine has been referred to before. The stock is fed into the small end of the cone from the hopper, as shown by the dotted lines, and after being opened is blown out by the fan through the outlet at the large end; the machine being usually arranged to blow the stock into a small room partitioned off for the purpose. The usual speed of the machine is from 800 to 1000 revolutions a minute.

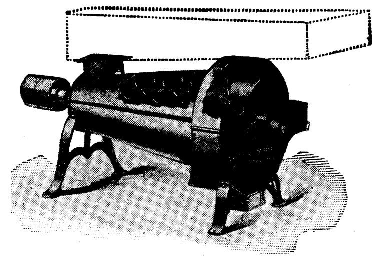


Fig. 9.

Fig. 10 illustrates the Curtis & Marble reversible flock cutter, *i. e.* the machine for transforming the flock stock as coming from either the rag cutter or flock renovator, into the product known as flocks. The special features of the machine consist in means for making the cylinder reversible and the blades self-sharpening; in the arrangement for feeding in the stock, and vibrating the cylinder; and in the mode of holding and adjusting the blades in the bed. The vibrating attachment prevents the cylinder from running in one place and wearing grooves in the blades.

In flock cutters where the cutting cylinder is made to revolve continually in one direction, the cutting edge of the blade soon becomes dull, and simply grinds or mashes the flocks; the only remedy in such cases is to frequently grind or sharpen the blades, which, of course, consumes much time and involves considerable expense and trouble. In the machine shown in the illustration, this frequent grinding is done away with, since the peculiar construction of the blades, the reversible feeding device and arrangement of the discharge orifices, render the blades self-sharpening. There are sixteen blades, 28″ long, in the cylinder, and nine blades in the bed. The central portion of the blades is iron, covered on each side with a plate of steel, welded onto the iron and hardened, so that the central portion will readily wear away and leave a steel cutting edge on each side. As the machine is used in cutting flocks, the natural consequence is that each of the blades is dullened at one edge and sharpened at the other. By means of the driving belts, the cylinder is made to revolve in either direction at will, allowing the sharp edge of the blades to be always used for cutting the stock, and as the motion of the cylinder is reversed, the flocks are carried in either direction and discharged at either end of the machine, while at the same time all the blades in both cylinder and bed are rendered self-sharpening. As the blades in the bed wear away, they may be adjusted from time to time either separately or collectively, as may be required. The machine has a capacity of 600 to 1200 lbs. a day, according to the kind of stock to be cut, *i. e.* ragstock or mill waste—hard or soft stock.

Directions for starting and running this flock cutter: The driving pulleys on the cylinder are 16″ diameter, 6″ face, and usual speed is 350 revolutions a minute. In starting the cylinder to run from you, close the inlet B and the outlet under A, and open the inlet A and the outlet under B, and feed in the stock at inlet A. Reverse the openings when the motion of the cylinder is reversed. Turn the screw D down hard enough on the spring to hold the bed blades up sufficiently close to the cylinder to cut the stock, but keep the bolt C tight enough to prevent the blades from coming together too hard. As the blades wear, unscrew the bolt C, and at the same time keep the screw D down onto the spring.

How long the cylinder will run before it needs reversing depends upon the kind of stock that is cut.

On soft stock it will run several days, while on hard rags it will need reversing every day; frequent reversing of the cylinder is desirable, as it will prevent the blades from getting very dull on one edge. The usual way of reversing the cylinder is to have two belts, one an open and the other a cross belt, changing the belts when it is desired to reverse the cylinder. Every time the belt is changed, the feeding box will have to be changed also to the other end of the machine. By this frequent changing, the cutting of the machine is kept in good condition all the time, and frequent grinding avoided.

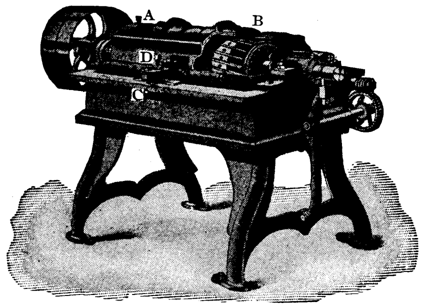


Fig. 10.

As the cylinder blades wear away, plane off the tops of the wooden lags between the blades so as to keep them about three-sixteenths of an inch below the cutting edge of the blades; when the blades are worn down considerably, take the wooden strips out entirely.

When the bed blades get worn down to within one-eighth of an inch of the iron lags, it is necessary to raise them, and to set them when they are raised, to the circle of the cylinder using the setting bar which comes with the machine for this purpose. Bring the blades up to the cylinder as you would in cutting stock, then take out the cylinder, lay the setting bar with the collars on it, which should be the same size as the bearings, into the boxes, and set the pointer to the bed blades; this gives the exact diameter of the cylinder. Then drop the bed sufficiently to allow the blades to be raised; loosen the four set screws protruding obliquely at the side of the frame, and raise all the blades by turning up the raising screws in the bottom of the bed till they touch the pointer on the setting bar; then put the cylinder back in its place, and grind the blades together with oil and emery, using about No. 70 emery. To grind the blades together with oil and emery, turn the cover of the machine over back and clean all the flocks from the cylinder and bed. Run the cylinder in either direction and apply oil and emery to the blades, the usual way being to have the oil and emery mixed together in a dish in the form of a thin paste, and apply it with a leather swab or pad made similar to a carder's strickle. Bring the bed blades close up to the cylinder and grind with the oil and emery until you have the blades of the cylinder and bed ground to a sharp edge. Be sure to vibrate the cylinder all the time it is grinding. After grinding, clean all the oil and emery from the machine before using. By drawing up on the four set screws, previously referred to, the knives are pressed together and are firmly held in position, even though the lower screws, by means of which they are placed in position, become loosened or even drop out altogether as sometimes happens.

In all ordinary use the cylinder will seldom need grinding, as the blades will be sharpened by reversing the motion of the cylinder. Should the blades get roughened or out of true at any time, it is well to grind them together, the same as is done when the bed blades are raised. When a new set of bed blades is put into the machine, the blades should be set to fit the circle of the cylinder and then ground together with oil and emery in the same way as described before. As soon as you commence feeding in the stock, it can at once be seen whether the grinding is done well or not. If the machine takes the stock without any effort on the part of the operator, then the work is done all right, but if the stock has to be pushed into the machine, it is a sign that the knives are not yet sharp enough. If the flocks leave the machine good and even and without nubs, everything is all right; but if they are all nubs and rolled up, and feel more like sawdust than flocks, then the knives should be drawn up a trifle and the effect noted. As soon as the product comes out even and smooth, proceed with the cutting and the machine will then do good work with frequent reversings, until the knives become worn down again. As it will not do to have the raising screws in the bottom of the bed fit tightly, on account of their liability to rust in, it is well to weave a string or lace leather around them from one to the other to prevent their jarring loose when the machine is running. Keep the bearings, worm gear and worm well oiled, and the boxes tight. On machines built within the last few years, there is an oiling device on the hub of the loose pulley, and in addition to oiling this pulley through the oil holes, take out the thumb screw and fill the recess with oil, which will work out through the wooden spline beveled into the hub; this aids very much in preventing its getting dry and wearing out the pulley. In feeding in from the hopper—which is set on top of the machine, though not shown in the illustration—the stock, unless it has been run first through a flock renovator, should be carefully examined, that no pieces of iron or other hard substances are fed into the cutter, otherwise the blades (by reason of there being two sets of blades working one against the other) will be broken. Even if the trouble should not be as serious as that, one point is sure, that the work turned out by the machine after a piece of iron has found its way into it will be inferior to that turned out before. The stock to be cut must be fed into the cutter as continuously as possible, so as to prevent the blades running without stock, since this would dull them quicker than when cutting.

Do not cut the flocks too fine for the reason that such a flock will not felt as well as a longer one, on account of possessing too little surface for the felting, and while such flocks apparently go on the goods more readily, they also leave or drop out just as quickly. A very fine flock indicates that the machine has been set too tight, so that the stock is being ground rather than cut.

With reference to the procedure of flocking the goods, there are several methods in use, all of which have their advantages and disadvantages; the best method in any given case will depend considerably upon how much weight has to be made up by flocking, how long the pieces will require fulling, and also upon the grade and condition of the flocks to be used.

Dry flocking is frequently used, for the reason that in this manner it is much easier to distribute flocks evenly all over the fabric than by wet flocking; this method of dry flocking may give satisfactory results in connection with lower grades of kerseys, meltons, beavers and similar fabrics, yet it cannot be used in connection with better grades of these fabrics, nor on fancy cassimeres, for the reason that too many of the flocks will work through the fabric, and thus get on its face, with the result that the colors and the face of the goods will have a dull, muddy appearance. When flocking dry, the amount of flocks required to be used is put on the goods immediately after starting the fulling mill, and after they are well distributed over the goods, then soap is applied.

Wet Flocking: The best plan to do this is to take about one-quarter the amount of flocks calculated to be used, and sprinkle them lightly on the goods when they begin to get warm in the fulling mill. Then after awhile, add another quarter of the flocks, and continue in this manner until all the flocks have been added. The flocks put on in this manner will adhere as firmly as possible to the fabric thus flocked and fulled, since the flocks are thus fed to the fabric when it is in a condition to absorb them best, *i. e.* when the fabric becomes heated, and thus felting starts.

Half dry and half wet flocking is used when a rather excessive amount of flocks must be added to a fabric, and where it would take too long to apply the flocks by means of wet flocking, for the reason that the goods would have fulled up in width and length before all the flocks were applied. For this reason part of the flocks are given to the fabric in its dry state and the rest after the goods have been wet and become warm.

WASHING.

This process, as a rule, follows fulling, and has for its object to thoroughly clean the fabric of all the impurities adhering to the structure. However there are instances in which the flannel is washed or scoured previous to fulling, either for special reasons or the fact that some finishers prefer such a procedure, claiming in this way more satisfaction with reference to production, as well as final finish. Again washing of the goods is also done in connection with piece dyes after dyeing, the same when goods are speck or burr dyed, or after carbonizing, etc.; however, in any of these cases the washing then is more or less a rinsing off (possibly using in connection with it fuller's earth or a mild scouring liquor or soap) for the fact that these goods originally had been once thoroughly washed or scoured previous to dyeing. In the present instance we refer to washing goods, as is practiced after fulling.

Closely examined, the washing of fulled cloth may be divided into two parts—the solution and loosening of the fulling filth, consisting principally of oil, soap, color residues and glue; and next, rinsing it away with either cold or warm water. These operations are sometimes performed separately, as many fullers first loosen the dirt in the fabric when the latter is still in the fulling mill, that is, after the fulling operation has ended, and then scour the cloth in the washing machine. They urge, as a reason for this procedure, that the dirt will come off better from the cloth still warm from fulling, than after it has been transferred to the washer, and possibly more or less laid around for a time. However in most cases, the goods after fulling has been finished in the mill, are washed in the washing machine or washer as the latter is called, and it must be remembered that the sooner the goods, as coming from the mill are washed, more particularly during warm weather, the easier and at the same time more thorough the process will be done. Whenever possible, never let the goods lay in a heap over night before scouring, try and enter them in the washer any way, even if only for a few runs, so as to cool them.

When the proper soap has been used at the fulling, and such soap retained its vitality to the end of the process and more, then there is no question but that the scouring of the goods is an easy process, in fact only a rinsing, especially if able to use luke warm water. However if the soap as used for fulling had lost vitality before the process finished or just at this point, the soap being of too light a body, then in this instance a scouring soap or liquor has to be used at the washing in order to get the goods clean.

Scouring Liquor. It is not necessary that the body of this liquor be heavy; quite the reverse, it is better to keep it light, and for which reason about one to one and one-half ounces of soap to the gallon water is sufficient. Again cheaper grades of soap may be used, for the fact that it is upon the strength of the liquor that reliance has to be placed, and for which reason the amount of alkali should be somewhat larger, than what is used in a fulling soap. The strength of the liquor however depends entirely upon the character and the condition of the goods. For example, if dealing with colors not fast to fulling, then it will not do to use too much alkali or else they may be injured. When the proper amount of ingredients has been well combined by boiling, the tank is filled up with water and left to cool. Just before the soap becomes cold, you may add to the mixture about one ounce of sal ammonia to the gallon, but if the alkali is ammoniated, one-half ounce will do. Stir frequently until well mixed.

Several pailfuls of this scouring liquor are given the goods, provided the lather does not show up good, *i. e.* the fulling soap has lost its vitality at the fulling, and after giving them 20 to 25 minutes in this, it is drawn off and the procedure repeated, and after that the goods are thoroughly rinsed. The same proceeding is applicable to goods that are washed before fulling.

Another good scouring liquor is made by adding about two ounces of pearl ash to each gallon of water the tank will hold. This mixture does not need boiling, since the pearl ash will readily dissolve. In connection with this liquor, use your regular fulling soap for scouring purposes. Wyandotte Textile Soda is also a most excellent article to use in connection with soap for scouring purposes, especially on account of its mild action on fibres and colors. On worsteds requiring no fulling, this scouring liquor made with pearl ash or Wyandotte Textile Soda will be found to give excellent results.

Water. Another important item for perfect washing is the kind of water to be used. The best to use is warm water, but unless this is plentiful at hand, cold water will have to do; however, there is nothing which will have as beneficial an effect upon the goods at the washing as a sufficient supply of luke warm water. To always have an even temperature for the water is another item of importance. The temperature for the water should not exceed 110° F. After the washer is started, turn on the warm water and fill its trough about half full, having previously closed all the gates, and let the goods then run in this water for about 20 minutes, and when there will be ample evidence of the vitality of the fulling soap used, for if it is right, the washer will be filled to overflowing with a thick, rich and creamy lather, although dirty, for it is tainted with all the impurities of the goods which have become loosened and entered into the lather by the use of the warm water. If the goods show such a lather, no scouring liquor will be required to be used for washing the goods, the procedure of scouring simply dissolving itself in a procedure of rinsing by drawing off the sud at the end of 20 minutes, and entering another supply of warm water, and allow the goods to run in this again 20 minutes. At this second scouring, the lather should show up white, and still be thick and creamy. When in turn this second sud is drawn off and the washer is about half empty, turn on the warm water and rinse the goods with it as long as the supply will last, and then turn on the cold water and rinse till all traces of the soap are gone. The time for this depends upon the supply of warm water at command and upon the nature of the fulling soap, which had been used. With an unlimited supply of warm water at hand, rinse the goods about half an hour and follow this with about half an hour in cold water, and when, as a rule, the soap will be found to be well out of the fabrics. Keep in mind that warm water will remove the soap faster than cold water, and that if no warm water on hand, the process will take so much longer. When using cold water entirely, it will be advisable to give the goods at the second water about a pint of diluted ammonia to each piece, which will help to loosen the soap and thus aid in its removal.

If however at the first water the lather does not show itself to any extent, and the suds look thin, instead of thick and creamy, it is a sign that the vitality of the fulling soap is gone, and for which reason a thorough washing must be at once given the goods, by drawing off this first water and giving each of the pieces several pails of a strong scouring liquor.

Ammonia. The action of the ammonia as an alkali for neutralizing fatty acids is strong. It saponifies fatty acids much better than potash and soda, and only its volatility makes it less suited for the manufacture of hard soaps for textile and other purposes. But then it is largely used as an agent for expediting the combination of other alkalies with the fats. This also explains its capability of increasing the action of other alkalies in washing, as well as that of soap. If ammonia is poured on cloth charged with soap, at the beginning of the scouring process, an essentially greater quantity of foam will be formed, the fulling filth will rise better and quicker, and the cloth is cleaned more perfectly. Ammonia is not only more effective for the raising of the filth, but it also expedites the rinsing off of the soap, a feature of the greatest importance in connection with goods to be dyed. As is well known, traces of soap will remain in the goods in spite of slow and careful rinsing. Such residues are for piece dyeing, just as those of oil or fat; but when ammonia is added before the final completion of the washing process, and an emulsion formed of it, then any residues left are almost entirely neutralized.

The ammonia is to be used diluted with from double to quadruple its volume of clean, cold water; adding one-half pint of this quantity at once at the beginning of the washing to expedite the dissolving of the fulling filth, and the other half only when the worst filth and foam have been rinsed away, so that the escaping water is of the appearance of clean soap water; a strong emulsion will then be formed again, which contributes essentially to the expulsion of the last traces of soap.

It is also of advantage to add a little ammonia to the fuller's earth, provided such is used for the final rinsing of the goods.

Ammonia may be used without fear for any tender shades, if a certain degree of care and a sufficient state of dilution are used. However there are several colors, the tones of which are slightly altered by ammonia—for instance, nearly all the reds, principally those of Brazil wool, madder, or cochineal. In doubtful cases the dyer can furnish the best information as to how far the use of ammonia is permissible for a certain shade. All the colors with some pretence to fastness—logwood black, alizarin black, indigo blue, alizarin blue, green and brown, also all the fashionable colors fast to fulling—may without fear be exposed to the influence of ammonia in washing, that is, provided if, as mentioned before, care and a sufficient diluted article is used.

It is not at all true that ammonia injures the feel of the goods, as is asserted sometimes, however, the use of ammonia requires the observance of one condition, and which is that goods treated with ammonia must not be placed in contact with metallic parts, at least not immediately after ammonia is poured on, since this contact will cause spots which are most injurious, especially for cloth intended for piece dyeing. Cuprous ammonia is formed instantaneously if such cloth touches copper or brass. The spots thereby are hardly noticeable in white or pale ground cloth, and only when held against the light do they appear as if colored feebly brown, but after dyeing, these spots are strongly pronounced and much darker, as cuprous ammonia makes the fibre more sensitive to the dye. The spots will appear almost black in indigo dyed cloth, and for which reason copper or brass bottoms or rollers must never be used in washing machines. For the same reason ammonia should never be used in fulling mills the lower cylinder of which has a brass rim, etc., etc.

Fuller's Earth. The softening and cleansing properties of this earth are appreciated by all finishers, who have come in contact with it, especially the refined product, and which is much to be preferred to the crude article, and like any other article in the end will be the cheapest; since the former will better combine with water, and the residue will not be as great. Do not attempt to use more of the earth than the water will hold in suspension without frequent stirring, since too much fuller's earth is worse than not enough. A good plan is to use to one barrel full of water, two pailfuls of the earth, using more will give unsatisfactory results. The proper time to use fuller's earth is any time after the goods are washed, *i. e.* fulling filth rinsed off.

If washing goods which had been burr dyed, a bath of the earth after rinsing will help much to prevent crocking, since the crocking of goods is always more or less due to insufficient rinsing after the goods have been burr dyed.

With reference to the machines for thus scouring the goods, there are two types, viz.: one where the pieces are dealt with, more or less, in a rope form, and several pieces or strings at one time, and the other where the pieces are dealt with in the open width.

The Rope Cloth Washer. Fig. 11 shows this machine (as built by the James Hunter Machine Co.) with portions of the framing cut away, portions of the machine itself being shown in sectional elevation, in order to show the interior arrangement of the machine which, as shown, consists of a more or less semi-cylindrical trough A for holding the water, the scouring liquor, and in which the goods are made to travel, each piece 1, 2, 3, etc., in one continuous string. Above this are two heavy wooden rolls B, C, one on top of the other, and in order to still more increase the pressure, the top roll is supplied with elliptic springs D, fastened by means of iron rods E, outside, to the framing of the machine. Outside of the machine (on the side not shown in illustration) these two rolls are geared to each other by means of very long toothed gears, which make the drafts uniform and prevent damage to the cloth. Rope scouring machines come in different widths, intended for either 4, 6 or 8 pieces to be washed at one time, and being known for this reason respectively as four, six or eight string washers, for the fact that each piece, after having its selvages sewn together, forms one continuous string. In some instances however, two or three pieces are sewn together to thus form one string. The strings of cloth, during the operation of washing, pass through guide rings F, G, and between the two heavy wooden rolls B, C, previously referred to, passing in turn over a small, prominently grooved roll H, set with its shaft considerably above the shaft of the top roll C, and which takes the strings of cloth from the two heavy wooden rolls, and allows them to run again to the bottom of the trough. If it were not for this roller, the goods would be liable to stick to either of the two large wooden rolls and be taken around with them, and thus bring things speedily to a snarl. This small back roller, therefore, must be watched to see that it works properly, in order to prevent possible damage to the goods. Below the bottom roll B there is placed a deep box I which catches all the suds and grease squeezed from the goods. In the bottom of this box is a gate, which, when open, allows the suds to pass down into the

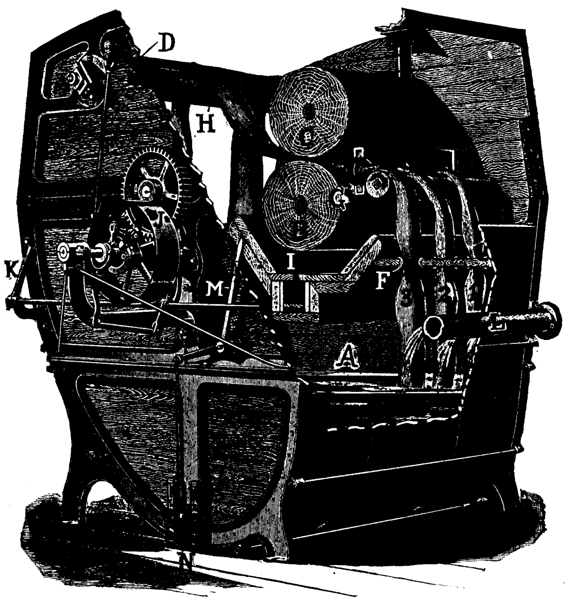


Fig. 11.

washer among the goods, until they are ready to be washed off, when, by opening a stop on the side of the washer, the gate in suds box is closed and the soap passes through a spout (situated on the side of the machine, not shown) on the outside and can be

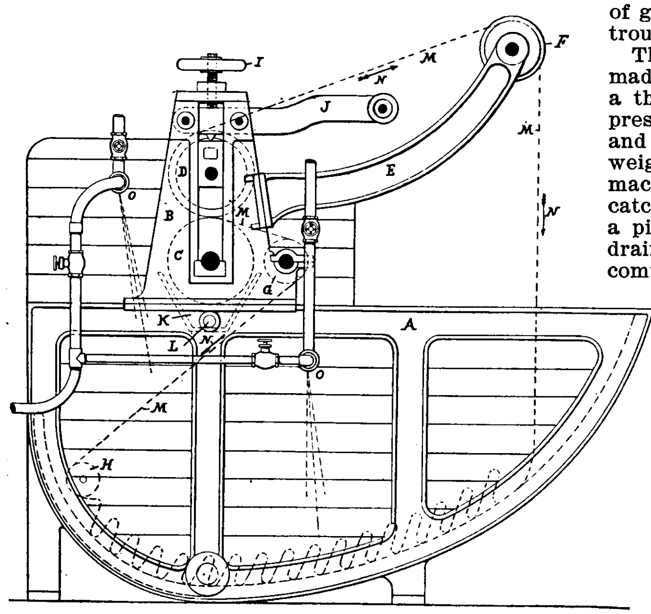


Fig. 12.

saved for further use if desired. All the greasy suds thus pass off without mixing with the goods while washing, insuring with the pressure on the rollers expeditious washing.

Power is transmitted to the machine by means of a friction pulley J, so arranged that it can be operated by hand levers K, one of which is placed in the front and one in the back of the machine (only one shown in the illustration), thus enabling the operator to stop the washer, when so required, quick and without damage to goods. L is the water inlet pipe delivering the water in heavy sprays onto the cloth under operation, as clearly shown in the illustration. M is a lever for raising or lowering slide valve N, for rinsing off the wash water, one of these levers and slides being placed on either side of the machine. When the washing has been properly effected, the goods are taken out of the washer, hydro-extracted, and when they are ready for the next process of finishing, as regulated by the character of the fabric under operation, they have to undergo.

The pieces scoured in such a rope washer, are certainly always more or less folded up, and are liable to contract creases, which, with fine goods, is undesirable; to avoid these creases and crimps, the pieces must be treated in a washing machine where they can be dealt with while full width or open. In general, these machines differ but little from the rope washer, previously explained, only they are made somewhat narrower, and only take one width of cloth at a time. Several pieces are stitched together, end to end, so as to make one long length, in order to keep the fabrics for a longer time in the wash water or scouring liquor, than if using one piece at one time, otherwise the manipulations are the same with each kind of machine.

The Open Width Cloth Washer. Fig. 12 shows such a washer in its side elevation, the same consisting of a strong framework A, which forms a support for the washing trough, which is of wood and is of a width to suit the class of goods to be washed. The upper frame work supports the gudgeons B which carry the two heavy squeezing rollers C, D. To the gudgeons B is fastened the arm E for carrying guide roller F, a second guide roller G being placed in the rear part of gudgeon B and a third, H, in the front part of the trough.

The bottom one of the two squeezing rollers (C) is made of wood, while the top one (D) is of wood with a thick sleeve of india rubber over it, and is kept pressed against the lower roller by its own weight and by the pressure of the hand screws I and weighted levers J (one of each for each side of the machine). A trough K below the bottom roller C catches the dirty suds squeezed out of the cloth and a pipe L in connection with it leads the suds to a drain, and thus prevents the main body of liquor becoming too dirty. The path the cloth follows is indicated by the dotted line M and arrows N. A service of warm water supply pipes are handily arranged, and from these two strong jets O play upon the fabric as it is fed through the machine.

SPECK OR BURR DYEING.

There is no other process in the finishing room as tedious as that of removing specks in the cloth by hand, either by means of the specking irons or by covering the specks by means of a pen with ink. Certainly, if the fabric contains only few specks, and when the construction of the cloth is such that it would be injured by the process known as speck or burr dyeing, then one or both of these hand processes certainly must be made use of, however in ordinary cases it is more advisable to use the burr dye process, since in this instance the face of the fabric is not disturbed as is the case when using specking irons, and when goods after this procedure, now and then, have to be sent back to the shear for smoothing the nap, before they are in a fit condition for being sent to the market. This in some instances may be due to the amount of specks taken out, or in other cases due to the dullness of the specking irons used, again it may be the fault of the girl who did the work. Since the process of burr dyeing is more or less a necessity in connection with a great many woolen as well as union fabrics, it next remains to explain how the process should be conducted, so as to give satisfactory results.

Burr dyeing has for its object to cover, *i. e.* color dark, only the vegetable specks or impurities in the cloth; it will not affect a wool speck, which the same as if no burr dye had been used will have to be removed by hand finally. Burr dye is made of logwood, blue vitriol and soda ash, a good recipe for it being:

Extract of logwood	48 lbs.
Soda Ash	30 lbs.
Blue Vitriol	12 lbs.

This should make about 100 gallons of a burr dye that can (properly diluted) be used with safety upon almost any kind of woolen or worsted, excepting cotton mixtures. The dye will stand at about 10°, and has to be diluted with cold water to suit the fabric under operation. This burr dye, as in fact all others, must be used only when perfectly cold, again it will not do to allow the goods to stand still in the liquor any length of time.

Another recipe for a burr dye is given thus:

Extract of logwood	200 lbs.
Soda Ash	110 lbs.
Blue Vitriol	50 lbs.

This should make about 200 gallons of a burr dye, and which also has to be reduced with cold water previous to using it. The extract of logwood as used for burr dye can without disadvantage be of an inferior grade, or hematine will do just as well. This logwood or hematine is put into a tank with sufficient water to fill said tank about ⅛ full. Then add the blue vitriol, turn on steam, and bring the mixture to a boil, after which turn off some of the steam and boil moderately, until all the vitriol has been dissolved; then turn off the steam and let the liquor stand for a few hours to cool, adding at the same time a pail or two of cold water. Then add the soda ash, but remember, very slowly and carefully, since as soon as the soda ash and the vitriol come in contact, fermentation sets in, and the liquor will begin to boil and rise, and possibly run over in the tank, and thus the best part of the coloring matter be lost. When all the soda ash has been added, let the liquor stand for some time, in order to give it a chance to slowly work, and at the same time, if at any time there are signs of it rising, add a little cold water. Agitate the ash gently until you can stir the liquor without it showing signs of much rising, then turn on steam and bring it slowly to boil, and in turn keep this up for about 4 hours. Next turn off the steam and fill tank with cold water, keeping the liquor well stirred while the tank is filling. When the process is finished, the liquor should possess clearness and richness (a clear plum or claret) of color, when however, if the color is muddy and of a dirty blue, gray or black shade, it is a sign that an error in preparing it has been made, and that the dye will give poor results when used. Never combine the coloring matter with the ash first and then add the vitriol, for in this manner the best strength of the extract of logwood is wasted, while if it is combined with the vitriol first and the ash added last, all of its power is retained. Combining the vitriol and ash with water, and then adding extract of logwood, will also give poor results, there being something in the extract of logwood which needs fermentation, and which is omitted by this combination of the ingredients. In the same manner adding all three ingredients at one time into a barrel or tank, and this to boil with a small amount of water, will also give a poor, if not valueless burr dye.

The more soda ash there is used, the deeper a claret the shade will be, while, if the amount of vitriol used is increased, then the shade will lean more towards the blue cast than the claret.

A point which sometimes puzzles a finisher is just how strong a burr dye should be in order to produce results. This, naturally, varies more or less with the kind of goods treated—that is, the character and abundance of specks and burrs which it has to conceal; also upon the method adopted in applying, as well as upon the time when the dye is used. Under ordinary circumstances, and upon a fair grade of stock, the dye will be found to work well at 1½ to 3°. The quantity of dye to be applied to the goods also varies with the amount of work which it has to do, and with the method of its application. Some finishers use the dye in the washers before gigging the cloth, and when about three pails of the 3° dye to the piece will do the work. The operation in this case is thus: Run the fabrics in the washer sufficiently long to thoroughly start the soap and dirt; and do not add the dye until a good clean lather has begun to show. Each piece should run in its three pails of dye for at least twenty minutes before the rinsing in cold water has begun.

However the best plan is to defer the burr dyeing until after the goods are gigged. In this instance, although we may use the same amount of dye,—about the same, viz., 3 pails to the piece—yet it is only necessary to have it about half as strong than if burr dyeing in the washer, in order to accomplish the same results, 1½° in most cases being then quite strong enough for all practical purposes.

A good method of applying the burr dye to the goods is thus: The dye is contained in a large square tank, a roller frame being adjusted in the tank and on which the cloth is run from a pile outside on the floor. The cloth is thus run up from the floor and down into the liquor, being passed over the top row of rollers and under the lower row alternately. Then just before it passes out of the tank, it is run between two large squeeze rollers, in order to save the surplus dye liquor, which thus runs back into the tank and is re-used. From these squeeze rollers, the fabric is run on a roller or directly into the washers for the removal of the loose dye and the final cleansing. In its passage between the squeeze rollers, attention must be paid that the cloth does not curl or wrinkle under at its selvages. By this method of burr dyeing, the cloth is not allowed to remain in the dye too long at a time, and the liquor is evenly and uniformly distributed over the whole piece, so that no part of the goods receives more than any other. Cloudy and shady goods will not be liable to form if care is taken.

In most cases however the burr dyeing is done in the washer, in which case let the goods run for about 20 minutes in the dye, after which they must be rinsed well, and given a bath of fuller's earth, which will prevent all danger of the goods crocking.

When dealing with union cassimeres, and all goods which have cotton warp and wool filling in their structure, we must resort to different plans for burr dyeing, or else a different effect will be produced upon the cotton from that produced upon the wool portion of the fabric, for the fact that if the dye were so made that it would produce exactly the desired effect upon the wool and cover nicely all the specks and dyes contained therein, it would be most likely to tinge the cotton in the fabric to such a marked extent as to materially affect the whole appearance of the piece. For such goods a good recipe for preparing the burr dye is thus:

Extract of logwood	175 lbs.
Soda Ash	140 lbs.
Blue Vitriol	90 lbs.

This produces 200 gallons of a dye which stands about at 15°, and which for dark shades should be reduced to 2°, and for light to 1°, while 2½ pails to a 6/4 piece, and from 10 to 15 minutes' application in the washer (considering a fabric previously gigged), will give proper results. The rinsing after this is a very important step, and must be carefully and thoroughly done, with a good rich flow of pure water, otherwise goods may crack. Plenty of time must always be given for this scouring or rinsing after burr dyeing, since, unless it is well done, this result is inevitable. If it is desired to produce a sort of a blue cast on these fabrics, a case often called for, it will be necessary to employ about twice as much blue vitriol and half as much soda ash. But here there will be trouble unless the greatest care is taken not to use too much of the vitriol for the good of the cloth. The amount which can be safely used will depend largely upon the condition of the goods, but under any circumstances enough should be used to cover all the burrs and specks, or else its purpose will have been in vain.

Any batch of burr dye should be always tested before it is used, and, if possible, kept exactly uniform for all similar styles of goods. Again it must be applied in even and regular quantities, and the goods must always be allowed to remain in the dye for the same length of time. The dye is always best in its action when perfectly cold. However, not only must we use a perfectly cold burr dye, but at the same time, the goods must be also in a cold state; and to make sure of this, give them about five minutes' run in cold water after putting them in the washer, but be sure and have them well drained before running them through the burr dye tank, or adding the dye in the washer provided no special burr dye tank is used. In the latter case, never leave water in the washer to thus reduce the dye, for such a procedure will result in uneven work. Always reduce your dye to the exact strength wanted before giving it to the goods.

CARBONIZING.

This process has for its object to liberate all vegetable impurities from woolen cloth. Although carbonizing should be practiced in connection with the stock before it is converted into yarn (see page 38), yet in many instances it is preferred to be done in the woven cloth. The carbonizing of goods will naturally omit their having to be speck or burr dyed. In most instances, *i. e.* the common way of carbonizing is by means of exposing the cloth for some time to the action of a sulphuric acid bath, and then dry, *i. e.* bake the cloth under excessive heat, and which then will reduce all vegetable matter to such a state of carbon that, with a vigorous beating, it will pass off as dust.

The carbonizing liquor for this process is made by adding sufficient sulphuric acid to the water with which the tank is filled, to make the liquor register 5° B., after which the goods are entered and well covered with the liquor and left there for about 25 minutes according to condition of the cloth to be treated. When ready to remove the goods, one of the ends is passed through a set of squeeze rolls as fastened to the tank, and thus any surplus liquor squeezed out and saved for future use in the tank. It must be mentioned here, that all the metal parts of the tank must be of bronze, for if not, the acid will destroy them. The tank also should be lined with lead, or if of metal, it must be of a non-corrosive kind. As soon as the goods leave the squeeze rolls of the tank, they should at once pass (guided into by means of a drum situated directly above the extractor) to the extractor with no more handling than absolutely necessary. This extractor must be acid proof, and its drainage such that all liquor extracted from the goods, returns to the tank, and is thus reused. Always be careful to keep the acid bath in the tank at its proper strength, by adding from time to time as required, more acid to it.

From the extractor the goods are then taken to the drying room to undergo the baking process, *i. e.* transfer the vegetable matters as now completely saturated with sulphuric acid, by means of drying under excessive heat, into carbon — dust, and in which state said vegetable impurities have to leave the cloth.

The drying room is supplied with numerous steam pipes in order to be able to quickly raise the heat to a high point, said steam pipes being so placed as not to interfere with the goods which are loosely hung up, in any way, to get the heat at all points of the goods. After being hung up, the room is closed and the steam turned on, and the heat run up to at least 175° F., since at that point only, the baking process will be completely accomplished. In other words, the strength of the acid bath, as well as the heat in the drying chamber, must be both, up to the required point for perfect carbonizing.

In some mills Can Dryers (as are used in connection with the drying of cotton goods) are employed in place of a drying chamber. Such Can Dryers consist of a series of metal drums, kept at a uniform temperature by a constant steam supply. These drums are driven (rotated) by power and the goods passed over them, and thus dried and in turn baked.

After thus carbonizing the vegetable impurities in the cloth, they in turn have to be removed, and which is done either by dry beating the cloth, or in case with bad pieces, by means of a heated fulling mill; this being a fulling mill supplied with steam pipes, placed out of the way of the run of the cloth. Running the goods in such a hot fulling mill, for about one-quarter hour or less, will remove every trace of carbonized vegetable fibre, provided the process itself was done well.

The next thing to be done is to send the goods to the washer and give them a bath in a solution of soda and water for about 25 minutes, in order to neutralize the acid, after which rinse them well; adding fuller's earth to the latter procedure will greatly assist. Previous to taking the goods out of the washer it will be advisable to ascertain if neutralizing has been thoroughly accomplished. If acid still remains in the goods, they will feel slippery, and when another soda bath, to be followed with a rinsing, has to be given to the goods.

STEAMING AND STRETCHING OR BOILING AND STRETCHING.

This process is generally practiced in connection with fabrics which are to receive a face finish. The "steaming and stretching" machine ordinarily receives the cloth from the extractor, and has for its object to smoothen out all wrinkles, prevent lightning effects caused by too long fulling, to sadden the cloth to its natural state, and finally wind the cloth under operation on to wood rolls ready for the gig or napper as the case may be. For improving the lustre and feel of face finished goods, as well as to remove wrinkles and creases in cloth that has laid around for a long time, and for steaming and stretching in general, this machine will be especially found of advantage.

The process itself is best explained in describing the construction and operation of the machine as built by the Parks & Woolson Machine Company.

In connection with this machine the cloth usually is run into the machine from the open fold, and passes first through tension bars, then over the first stretch or expansion roll to the second stretch or expansion roll. Between these two rolls there are several lengths of perforated pipe by which the steam is let on to the cloth as it passes over the fabric, thus receiving the cloth while it is in a perfectly smooth condition, and from where it goes directly to the winding roll. The machine will handle the heaviest or lightest goods equally well, as the tension of the cloth and the hardness of the roll can be regulated. All the running parts of the machine are gears or sprockets and chain, so there are no belts to be affected by the water or steam. Some of these machines are built to fold the cloth off on to the floor, in place of winding it on a roll, again some have both attachments applied, either one of which can be used as the case may require.

This machine is also built with a boiling tank, so the cloth runs through boiling water, the latter being boiled by perforated steam pipes set in the tank and in which instance, the machine is termed a "boiling and stretching" machine. Some machines again are built, having both attachments (steaming and boiling) added, either one of which may be used. Again the regular steam box (see Figs. 61 and 62, page 356, as then explained in connection with the article on "Steaming") can be substituted for the perforated steam pipes, if preferred. Larger machines having three stretch rolls, double the steaming capacity, and a large brush with two or three cloth contacts are also built.

The Curtis & Marble Cloth Stretching and Rolling Machine with Hot Water Box. The purpose of this machine is identical with that of the Parks & Woolson Stretching Machine, previously explained. Fig. 13 shows this machine in its perspective view. It has similar tension bars in front for giving any desired tension, a revolving stretch roll in the centre to draw out wrinkles, and a large drum at the back on which the cloth roll rests while winding, with heavy weights to make a firm, even roll. The stretch roll has brass trucks and slides inside, and hard wood slats on the outside, cut with ratchet like teeth. Both ends of the stretch roll turn exactly together, and any cramping or uneven drawing of the goods is avoided. The stretch roll is driven by gearing at the same speed as the cloth, so as to relieve the goods of any strain required in turning it.

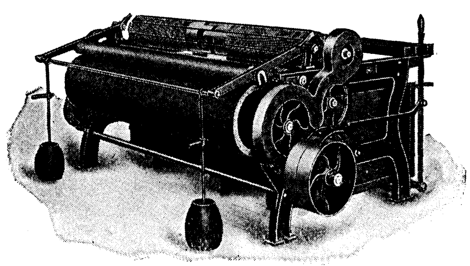


Fig. 13.

A revolving screw roll with coarse right and left hand threads, is commonly placed between the stretch roll and the winding drum. This roll is driven by gearing and prevents the edges of the cloth from drawing in or turning over.

A large hot water box is placed in front so that the goods may be run through hot water and softened before passing over the stretch roll. The rolls around which the cloth passes in the bottom of the hot water box are made of brass and run in brass bearings to avoid rust. As will be readily understood, the machine may also be used without the hot water box. When dealing with fabrics requiring softening, but containing colors not fast enough to stand the action of hot water, a steaming device is put on. Again a brushing attachment, to act on the goods after passing through the hot water and before reaching the stretch roll, can be provided, if so desired. For this purpose a brush cylinder, about 13 inches diameter is used, filled with either stiff bristles or wood fibre.

The heavy gearing on the machine is protected by gear guards, to avoid accidents, and the weights are provided with handles for convenience in lifting them on and off. The machine is built for handling either 6/4, 7/4, or 8/4 wide goods.

Boiling and Stretching Piece Dyed Worsteds, and Light Weight Union Fabrics. In connection with the latter class of fabrics, made with cotton warp and wool filling, the different hygroscopic, elastic, and other physical properties of cotton and wool, cause such materials, if they were simply scoured in the ordinary way to contract or shrink irregularly over the entire surface of the cloth, giving the finished fabric a rough shriveled appearance. To overcome this trouble, these fabrics, after first being singed, are subjected to the action of what is called the wet finishing machine (which is more or less identical with the boiling and stretching machines previously explained), in place of a crabbing machine as was formerly done, previous to scouring and steam lustring; this so called wet finishing process preventing any imperfect appearance of the finished fabric, on account of the different materials combined in its construction. This same feature will also refer to Union Worsteds, may it be Worsted and Wool, or Cotton and Worsted. In connection with piece dyed worsteds, the chief use of this wet finishing process rests in thus preventing their excessive shrinkage during scouring and more especially during dyeing.

Provided any of the fabrics quoted require any fulling, it will be readily understood that they are subjected to this process previous to said wet finishing.

As mentioned before, the purpose of this wet finishing process is to limit the shrinkage or felting capacity of the wool fibres in the fabric as much as possible, and at the same time lay the filling in its proper position in the texture. This prevents in a measure the subsequent shrinkage of the fabric, more particularly in its width, and also its drawing out of shape in the succeeding operations of scouring and dyeing. This process of wet finishing is based on the fact that the wool fibre becomes fixed by heat, humidity, and pressure, and the wet finishing machine enables the finisher to obtain this result.

Worsteds differ essentially with reference to their finishing operations from that of woolen cloth. With the latter, the aim of the finisher is to preserve the vitality, *i. e.* shrinking capacity of the fibres, as long as possible, while in connection with worsteds, all finishing operations are designed with the point in view to eliminate these natural tendencies of the wool fibre from the very start.

This wet finishing machine consists of a series of four tanks, of which the first three, as a rule, contain hot water, and the last tank cold water, each tank being equipped with guide rollers, stretching rollers, and squeeze rollers, for guiding, opening the fabric to its full width, and squeezing it. The wool fibre thus softened in the boiling water in the first three tanks, and cooled evenly and thoroughly in the last tank, retains its form in that position much more readily in the cloth structure, losing at the same time its felting capacity. Again all four tanks of the machine may contain hot water, the goods then, after leaving the machine, being rolled up and left to cool while lying in the rolls (similarly as done in connection with the boiling and stretching machines—previously explained), the fibres in this manner retaining their position (they being *set* as we might say) more thoroughly than if treated as before explained, they losing in the latter instance all tendencies for a further shrinking.

Figs. 14 and 15 are descriptive diagrams of the wet finishing machine as built by the Arlington Ma-

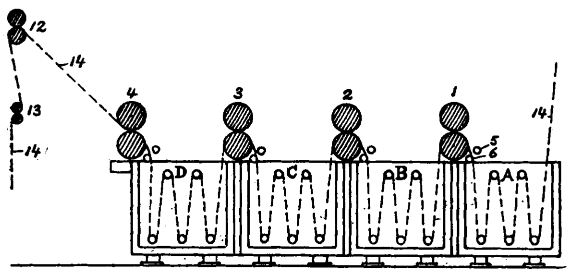


Fig. 14.

chine Works, and of which Fig. 14 shows a section, taken lengthwise through the machine, Fig. 15 being a view in detail, enlarged compared to Fig. 14, of the lower roller of one of four pairs of squeeze rollers 1, 2, 3 and 4, showing also the two spiral rollers as placed in front of each pair of squeeze rollers, the gearing for the various rollers, as well as a portion of the framing of the machine to which the parts referred to more particularly belong, being also shown.

As mentioned before, the wet finishing machine consists of four independent wood tanks A, B, C and D, each fitted with a series of five brass rollers in proper position for threading cloth, see dotted line, through each tank, so that it is thoroughly saturated and boiled.

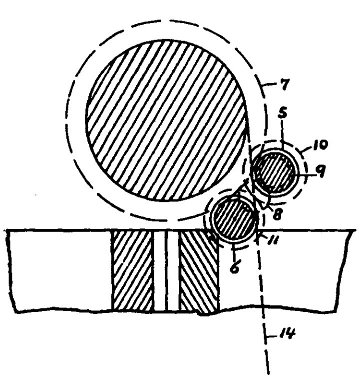


Fig. 15.

Between the tanks and at the end of the last tank, are arranged four pairs of iron nip or squeeze rollers 1, 2, 3 and 4, and before these rollers are placed within practical proximity to surface of each pair of squeeze rollers, revolving adjustable spiral rollers 5 and 6, as shown more in detail in Fig. 15, for keeping the cloth smooth before entering the nip of the respective pair of squeeze rollers. These adjustable spiral rollers are run in opposite direction to running cloth, by means of spur gear 7 on lower squeeze roll, meshing into a small gear 8, which is then meshed into gear 9, which drives spiral rollers 5 and 6 through gears 10 and 11.

The cloth, see dotted line, after leaving the last pair of squeeze rollers 4 of the machine, is then threaded through guide rolls 12 and in turn through plaiter 13, which folds it either on a truck or on the floor.

The wooden tanks are secured to their relative positions by iron framing running the whole length of the sides, and of suitable design for carrying housings for nip or squeeze rollers. The whole machine is driven by outside line shafts and bevel gears through bottom rolls. Dotted line 14 indicates the run of the fabric through the machine.

This machine by means of its most thorough construction, treats the goods evenly all over, every inch getting exactly the same treatment. The boiling water and the squeeze rollers tend to free the goods from soap, provided the goods were fulled any, or from other foreign matter, like size, starch, oil, dirt, dyestuffs, etc. The chances for water marks, washer wrinkles, and cloudiness, are by the use of this machine reduced to a minimum. If preferred, the machine may also be used after dyeing. The capacity of the machine, as claimed by the builder, is about 7000 yards of goods treated in 10 hours, certainly depending a great deal on the class of goods under operation.

GIGGING.

After the pieces of cloth are taken out of the washer, they in turn are allowed to drain for awhile and then are folded out evenly on trucks. The particular finish which the goods are to receive, plays now an important factor in the process of wet finishing. If the goods are to receive a face finish they should be run on a steaming and stretching or boiling and stretching machine (as previously explained) before gigging, and left in their rolled up condition for from twelve to fourteen hours according to the amount of felting required, before being sent to the gig; however, this process thus referred to is not required if dealing with goods designed for a "clear face" finish, also known as "threadbare" finish, or if they are what is termed "fancies;" it then being only advisable to partly extract the superfluous water from the goods, after they come from the washer, and then roll them up, and when, after draining for awhile, they are ready for the gig.

Low grade goods, containing cotton, or lots of shoddy, or colors liable to run, if they have to be gigged, on account of the finish required, are best dried at once after being taken from the washer, since if allowed to lie wet for any length of time, they are apt to have the colors run into each other, and thus spoil the appearance of the fabric, whereas if dried at once, when taken from the washer, and in turn gigged dry, they will more than make up in good looks what they lack in softness to the touch of the hand, on account of not being wet gigged.

If the fabrics are intended to be rolled up, after coming from the washer, they are taken to a "stretching and rolling" machine. The goods in connection with this machine, pass over a stretch roll, previously to being wound on a roller, to make sure that they are smooth and free from wrinkles. The tighter the pieces are rolled on this machine, the better they will drain, and the smoother they will be, a feature of special value when dealing with face finished fabrics. After the pieces are tightly rolled up, they are either laid down flat on skids or stood on end, and left over night to drain. In either case, even though the rolls are turned occasionally, the goods are sure to have more moisture on one side than on the other, a feature liable to create an unevenness in the gigging and thus in the final finish to the fabric, for which reason the use of squeeze rolls has come into much favor. Not only will their use result in fabrics containing as much as possible evenly distributed moisture throughout the roll of cloth, but the time required for their draining is also considerably shortened, since the squeezing can be so controlled as to have the goods, except such as are intended for face finish, at once in the proper condition for the gig, certainly a saving in time.

However in connection with face finished fabrics this rush will not do, since they will finish better if they are not hurried through the wet stage, are boiled and stretched, and in turn allowed to remain for about 14 hours in a rolled up condition previously to gigging. Provided no boiling and stretching machine at the disposal of the finisher, let these goods lie a day or two in smooth even piles in the wet previously to gigging them. Having thus prepared the fabric for gigging, we now come to this process proper.

Gigging consists of the combing or teaseling out of the several fibres which in fulling have become felted together on the face (and back) of the goods. To make a really uniform fabric the gigging must be exactly alike in every part of the piece, and no spot must be subjected to any amount of working of which another is deprived.

In gigging as it is carried on to-day there are three considerations connected with the mere mechanical part of the work which it is very important to notice.

The first of these is the teasel,

The second is the tension of the goods as they are brought into contact with the running surface of the cylinder, as covered with teasels, and a

Third that may be mentioned is the condition of the fabric as regards dampness during the gigging process.

The Teasel is a part of the gig which usually gets but little consideration, far less indeed than it really deserves. The teasel is the fruit of the thistle, which by careful cultivation has been brought to such perfection that for hundreds of years there was nothing which could in any way compete with this natural product for the purpose of raising the nap on woolen cloth. It is held by many manufacturers and finishers of fine grades of face finished woolen fabrics, up to the present time, that it is impossible to displace the teasel, however, the wire gig, *i. e.* the Napping machine is fast winning friends amongst Woolen Manufacturers, certainly on account of economy, and in connection with some kinds of fabrics has completely superseded the teasel, whereas in connection with others both are used.

The teasel point possesses a certain rigidity and at the same time a degree of elasticity which no manufactured article that has ever been discovered can attain. If the teasel point comes in contact with a knot or lump on the surface of the cloth, it will be bent back by the velocity of the cylinder, but after the bunch is past, the point returns to its original position and no damage is done. From the nature of the teasel point the teasel certainly is particularly well suited for this gigging. Not only is it made up of a barb or point similar to a wire or steel point, but all along the edges of the barb there are little teeth or points which add their part to the ease with which the barb is enabled to do its work. It is for these reasons that the teasel seems so much better adapted for working up the felt of the fulled cloth into a nap and in opening up the fibres so that all imperfections and foreign substances are removed, for which reason where it is used in the mill, its care and preservation demand the special attention of those who have anything to do with it.

When a lot of teasels is received at the mill it should be stored in a dry place where the teasels will not absorb moisture and become limp and useless.

In making use of the teasel the two great points to be kept in mind are the mounting in the teasel slat, and the wear upon it after it is in use in the gig.

In the mounting of the teasels in the slats, which is a framework of iron designed to hold the teasels in place and present a smooth, that is even, surface to the cloth to be worked upon, much effectiveness to the teasel is secured. They must be set in the slat so firmly that they will stand all the speed and working about which will be brought to bear upon them after they are in the cylinder. There must be no open spaces between them, and the teasels must be as much as possible of one quality. Some advocate moistening the teasel before it is mounted so that it can be the more firmly and easily pressed into place. If such is made use of the usual practice is to take a basket full of teasels at a time and steam them slightly, which will soften them and in turn make them easier to be handled. However it must be remembered that a teasel in a moist state is soft and therefore useless, again moisture will destroy its life, so that in order to make the slats thus mounted of any use, they will have to be quickly and thoroughly dried. This means a corresponding loss in time and labor before the teasel ever reaches the stage where it can do work, a fact certainly against this procedure of steaming or moistening teasels for the sake of setting them easily. Again when the fingers of the teasel setter are properly protected, teasels may be set in the dry state just as evenly as if they were moistened, and this more effectively. It may at the beginning take more time for him to set a certain number of slats, but that will be only a short while and then he will be just as expert at it as if setting moistened teasels. The teasels are then not injured and can be pressed together just as solid and just as even as if they were moist. Teasels mounted in the dry state are apt to stay in the frame longer than those mounted in the moist state. Mounting teasels requires a good, quick eye, since it will not do to mount these teasels carelessly, they must be properly sorted first and afterwards still more or less selected as to size during setting or mounting the slats, since otherwise an uneven surface would result, and in consequence uneven and streaky work produced. Some shipments of teasels come to the mill with their stems cut off close, while others have stems 4 or 5″ long left on.

The slats for receiving the teasels are made of two strips of flat iron and the stems of the teasels are drawn through this opening between two strips of flat iron, which gives additional support for the teasels and helps to hold them in place. When the slat has been filled, the protruding ends of the stems are cut evenly off with a sharp knife. In connection with wood frame slats, teasels minus stems are used, and if they have any, they must be cut off and this previous to steaming, provided this is practiced in the mill. The teasels must be then pressed into the frame and against each other as solid as possible so that after they are put into the cylinder, and the latter is set in motion, they will not fly out.

The proper selection, *i. e.* buying of the proper size and quality of teasels is another important factor for good work at the process of gigging. There is no reason why the teasels should not be of a size to fit the slats. For instance why should we use a 2 inch teasel with what are termed "buttons" to fill out with, when a box of teasels ranging from 1½ to 1¾ inches would make a better slat and this with less trouble? It must be remembered that a 2 inch teasel as a rule is more expensive than a 1½ or 1¾ inch teasel, again that "buttons," *i. e.* small unripe teasels amount to nothing more or less than throwing away of good money for very poor material. Certainly growers and sellers of teasels must get rid of them, for they are of no use to them, neither to anyone else. However, the price of these "buttons" is somewhat tempting to manufacturers, the same being as a rule so low that it seems like a fair investment on their part to use them; but it should be remembered that these buttons or small teasels are not as well matured as the full grown ones, they being open and soft, and their usefulness in the actual process of gigging amounts to nothing; they simply fulfilling the purpose of holding the teasels which do the work in their proper place in the slats. If this purpose however is attained, by teasels which are effective in the process of gigging, certainly much less dead or useless material has to be handled. Again if the proper size teasel is bought by the mill, it must be remembered that it is not only easier for the teasel setter to mount the slats, but that every one of the teasels in such a slat will be of some decided usefulness, in turn reducing the cost of the teasels as well as the expenses in setting them in slats.

When the teasels are properly set, with the whole surface of the teasels as they are ranged in the slat, uniform and regular, there is no reason why they should not run on ordinary woolens for eight or ten days and do good work.

Tension.—With reference to the next question, that of the tension of the goods, we come to a matter which requires the most careful attention and manipulation of the operator. It has always been one of the greatest and most important points to builders of gigs to construct a machine by means of which it is possible to regulate properly the tension of the cloth as it is stretched before the cylinder of the gig, in order to allow the machine to do its most effective work and yet bring about the best results in the cloth. The difficulty however is one natural to the process, the trouble resting not so much with the machine as it is with the goods. If every piece of goods that has to be gigged came to the machine in exactly the same condition as regards weight, stock and construction, then the matter of tension would be very simple indeed; however this is not the case, since fabrics vary so much in weight that an equal tension on two different pieces which differ slightly in weight per yard would result in a perceptible alteration in the appearance of the face of the goods, and which difference would only be heightened during the successively following procedures at finishing. Again differently constructed fabrics take in turn differently to gigging, and when the latter process must be always more or less regulated to suit the kind of cloth under operation. If for example the pieces of cloth under operation are made with a different number of picks to the inch, then the same amount of tension given to the fabric cannot possibly bring about similar results. Thus it will be advisable for the operator to know enough about the construction of the goods to be gigged, in order to be able to regulate the tension so as to produce as nearly as possible uniform results to fabrics under operation. This however, is no easy task, and can only be accomplished after considerable experience and skill on the part of the operator. This difference in tension as required for different fabrics, may not amount to very much where the goods are heavy and do not require a great amount of work, but if the goods happen to be light and the gigging correspondingly light, the difference in tension required is then quite an item.

Condition of the Cloth.—As regards the third point, the condition of the cloth in the process, there are two different questions that arise. These are the differences between wet and dry gigging.

Where the cloth is gigged damp or wet, the fibres will naturally tend to lie down close to the body of the fabric, and when the piece gets to the shear the revolver blades pass over them and leave them much as the gig left them, at least so far as the bottom is concerned. The cause of this is found in the nature of the wool fibre, which more readily retains its position when damp. The teasel serves to comb and lay the nap in a certain way, and when the shear gets at it, it is with difficulty that it touches it at all. In cropping, a wire raising brush, run a little faster than the goods, raises the nap perfectly.

The wetting of the goods is accomplished by means of an ordinary sprinkling can, or by a series of perforated pipes, so arranged as to eject a stream of water at the proper time and place. It is in this way that such goods as doeskins, broadcloths and beavers, some kinds of worsteds, etc., are treated, and it is the distinguishing feature of many of the finest finishes in the market.

By the other method of gigging, *i. e.* dry gigging, a different kind of finish entirely is produced. The fibres being dry do not retain the position which they are given by the action of the teasel, but have a tendency to stand up in their natural position, the teasel points get down further into the body of the goods, and thus work up a fuller and richer nap, and leave it in such a condition that the blades of the shear can readily reach most all the fibres. None of the fibres are lying down close to the weave of the goods and there are none of them but what can be brought up into contact with the shears by the use of a hard brush, which every shear contains. The character which this treatment gives to the finish may be described as a close, threadbare or clear face finish, the nap as raised by the gig being in turn cut off short by the shear. Clear face goods, many classes of dress goods, and worsteds and fancy cassimeres, are as a rule finished by means of dry gigging.

In both cases, whether wet or dry gigging, care must be taken not to push the cloth too forcibly on to the teasels, or a tender fabric will be the result. The teasels should be started slowly and gradually and with the oldest and softest teasels first, then the sharper may be used as the work progresses. Again there is a certain limit for gigging, to go beyond which is harmful to the strength of the fabric thus treated. To give, therefore, to all pieces of certain style of fabric the same kind of treatment will in a great many instances result in failure, for although some of the pieces will finish perfect, others will be spoiled. Therefore, in order to perform gigging intelligently, it is necessary for the finisher to study the construction of the goods carefully, he must see what kind and amount of gigging each individual piece may need or is able to stand.

The Up and Down Single Contact Gig. With reference to styles of gigs used, this gig, as the oldest and most simple gig, will be best mentioned first. The same consists of a framework which supports a large cylinder from 36 to 40 inches in diameter upon which the slats containing the teasels are placed and by one or the other contrivance held in place. Above and below this cylinder are found the cloth receiving rolls and a little way above the bottom roll and also below the top roll there are brackets supporting smaller guide rolls, the upper one being movable so that it can be slid in or out at will. Before the cloth is put on the machine, the slats on the cylinder are examined as to the sharpness of the teasels, remembering that all gigging must be started with the dull teasels, since the fibres on the surface of the fabric are all more or less heavily felted or matted down to the body of the cloth, and when if teasels with sharp points were used, they would take hold too hard and the fibres would be torn out, both to the injury of the cloth as well as the teasels. After the proper teasels, *i. e.* "work" has been put on the cylinder, the fabric is put on with the head or number end on top, that is, the end from which the nap is intended to run. This gig closely resembles the Up and Down Wet Gig illustrated and explained later on (see Fig. 19, page 324).

The top as well as the bottom cloth rolls, previously referred to, are provided with aprons of a length sufficient to go once around the roll and then reach to the other. Each apron is fastened to hooks on the roll, the other end being either sewed or wired to the respective end of the cloth, *i. e.* one apron to the head end of the fabric, the other apron to the other end of the fabric.

After threading the fabric to the apron of the top roll, the guide roll below said top roll is then run out its full length and the cloth run on the top roll, starting the machine, by moving the shipper handle to the right hand as far as it will go.

This shipping mechanism is such that when the top roll is engaged by turning the handle to the right, the bottom roll is released and will turn as the top roll pulls the cloth upward. If again, the handle is turned to the left, the top roll is released and the bottom roll engaged, whereas when the handle is pushed in the centre, both rolls are released and therefore stand still, the cylinder alone continuing to rotate.

As soon as the cloth is very nearly wound on the top roll, the shipper lever is placed in its centre notch, which stops the rotation of the two cloth rolls, and when the apron of the bottom roll is sewed or wired to the other end of the cloth in the same manner as done with the head end of the fabric, taking care to have the apron run outside of the bottom guide roll. The shipper handle of the machine is then turned to the left, which sets the bottom roll in motion and in turn winds the cloth, as coming from the top roll, on it.

Each of the cloth rolls is provided with a brake by which the tension of the cloth is controlled.

The brake is now applied to the top roll until the required tension is reached and the top guide roll is run in until the cloth is brought lightly into contact with the teasels on the cylinder. When the cloth is run on the bottom roll and the apron has reached as far as the bottom guide roll in its downward course, the shipper lever is then turned to the extreme right and the cloth begins to travel upward. The brake, *i. e.* tension on the top roll is now released and applied to the bottom roll, and as soon as the apron is past the cylinder the upper guide roll is turned somewhat inward so as to bring the cloth somewhat more, *i. e.* harder in contact with the teasels.

When the end of the cloth has passed the upper guide roll, what is termed as one "run" of the fabric has been completed and by this unit of work the amount of gigging done is expressed, by what we mean that for example "four runs" mean that the cloth in question passed over the cylinder eight times, *i. e.* has passed from top to bottom roll and back again four times.

When the fabric has been sufficiently gigged, the machine is then stopped by running the belt on the loose pulley, and the respective wire pulled out of the apron and the cloth, and the latter folded nicely on a truck. With full runs, and which is generally the case, the cloth is thus folded as coming from the top roll.

Now upon examination of the slats it will be found that the teasels have gathered and retained any amount of fibres, as combed from the cloth, and known as "gig flocks," in fact enough to make it impossible for the teasels to do any more work, and, therefore, the slats, *i. e.* the teasels must be cleaned from these gig flocks. Various methods are employed for doing this work, in some mills they are cleaned by means of hand cards, whereas in other mills the slats are turned on the cylinder, thus presenting a fresh side of the teasels for gigging, and then when both sides of the slats have become filled with flocks, they are taken out of the cylinder and brushed, *i. e.* cleaned on a special machine (revolving brush) provided for this purpose. Next the fabric is turned bottom end up, and the truck turned. What was before the last end, but is now the first, is then sewed or wired to the top apron and the goods run on the top roll; the bottom apron is then put on and the process of gigging, as explained before, repeated, this procedure being known as "reversing."

Up to this point most all goods are treated practically alike, but now we face the question of the finish for the fabric required, regulating the further process of gigging; the process as until now explained having been more particularly only quoted in order to be able to explain the general construction and operation of the most simple built gig, but which, at the same time, holds good in its principle for any make of modern gigs, the construction of which will be later on treated.

A feature of the greatest importance in connection with gigging is the grading of the slats into sets of different and increasing degrees of sharpness in order to be able to give fabrics of one style practically the same amount of gigging, and not have some of them treated one way and the others another way. To do this properly, the number of slats required to fill the cylinder must be taken into account and this number divided into sets with equal numbers and have that many degrees of sharpness of teasels; however, when dealing with face finish fabrics, it will be advisable to have more degrees of sharpness to slats than could be well made by dividing the slats of one cylinder into sets, in this case, for example, grading the slats in sets of six each and make from eight to ten grades of teasels. This grading of the teasels is made necessary for the reason that all gigging must be started with dull teasels, and the sharpness of the teasels used increased as the progress of gigging demands. If we would start with all, or even too much, new work, *i. e.* slats of new teasels, known as "breakers," both the fabrics, as well as the teasels, would suffer, for, being stiff and sharp, the points of the teasels would, as soon as they come in contact with the cloth, get caught in the felt and tear out the fibres, thus destroying the strength as well as the finish of the cloth under operation, and at the same time the teasel points would become so mutilated that the slat would be of very little use thereafter.

Always remember during gigging to closely examine how well the felt is raised, as well as the strength of the cloth, so that no tender fabrics will result. The slats must also be carefully watched, in order that the several grades are kept at a uniform sharpness, as well as to use up the slats, *i. e.* teasels in the frame, completely. It certainly will be understood, that slats, *i. e.* teasels as used, correspondingly change in their grade, *i. e.* gigging properties.

When testing the fabric under operation for its strength, take both of your hands and pass the cloth between the forefinger and thumb of each hand, having the thumb on top, and bring the hands close enough together to have the finger ends touch each other, then hold the cloth tight between the fingers and bring the knuckles of the thumbs together, being careful that the cloth will not slip between the fingers. In this way you will readily ascertain the strength of the cloth under operation. It is a well known fact that by means of this procedure, by some practice you are able to burst the strongest fabric. However it is not at all necessary for you to do this, simply strain the fabric gradually and you can easily note when there is a tendency for the goods to part. Always test the fabric near the end, in order that if a hole is burst in the cloth, the damage thus done will be at a minimum expense to the mill.

In order to ascertain the amount of gigging given a fabric, insert one of the small blades of a penknife under the nap and lift and lay back the fibres, in this manner exposing the ground. You can then easily tell if all the fibres are raised or if some of them still cling to the body of the structure.

Never take a fabric from the gig until thus tested with reference to its strength, and more particularly yet, regarding nap sufficiently raised, and there will be no trouble at the shear and goods will not have to be sent back to be re-gigged.

Besides the single contact gig previously explained, there are several makes of other gigs in the market, viz.: the up and down two contact gig, the rotary gig, and the two cylinder gig, they all having their special points of advantage in their construction, their chief aim being increase in production, without increase in labor.

The Up and Down Two Contact Gig will do much more work per day and per man than the common up and down single contact machine previously explained, the increased output being effected by a cylinder of increased diameter (42 inches) with two applications of the cloth to it. A perspective view of this gig as built by the Parks & Woolson Machine Co., is given in Fig. 16, showing that two large adjustable contacts or breasts, in this machine, are the means for about doubling the amount of gigging as compared to the single contact gig. These two applications have a quick acting geared adjustment from two of the heaviest possible contacts, to a distance of four or five inches entirely free from the cylinder, which feature enables the operator to conveniently run on new pieces, sew the seams and apply temples or stretcher sticks.

The path of the cloth is free from sharp turns and any number of temples will run nicely on it. Reversing and stopping the cloth is governed by one lever, independent of other motions. The friction to the cloth rolls is handy, efficient, and capable of the heaviest or lightest tensions. There are twenty-four iron flats to the cylinder used in connection with this gig, and which are staggered or set alternately to the right and left by pairs so the cross irons will not rotate in the same line.

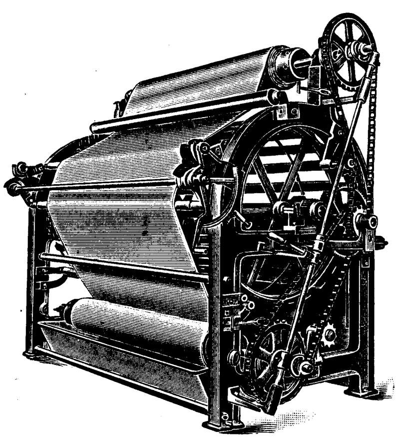


Fig. 16.

Special attachments, as may be used in connection with this gig, are a rolling attachment located in front of the machine, which rolls the cloth onto a removable wood roll from the lower draft roll. It is operated by a clutch, and will make a hard even roll. A cylinder vibrator, for a two inch stroke, is another one of these attachments, and which by means of vibrating the cylinder during gigging will greatly assist the teasels in raising a most uniformly even nap all over the surface of the fabric. A sprinkler pipe is placed just beneath the lower cloth application, and which applies water directly to the face of the fabrics under operation. Two stretch rolls, one for each contact, are also sometimes met with in this construction of a gig. By shifting the application roll gearing up onto the stands as fastened to the side frames of the machine, the latter can be readily changed into a one contact machine, when it is desired to get a very long heavy contact, *i. e.* application of the cloth on the cylinder; thus the machine can be used either as a single contact or two contact machine, as best adapted for certain fabrics made by the mill. When this gig is used with the two contacts, the length of those two contacts combined, can be made about twice as long as that of the regular one contact machine.

The Rotary Gig. In this make of a gig the cloth after once put on, the ends are nicely sewn together, either by machine or hand, in such a way that the seam ends are on the back, presenting a smooth face to the cylinder, the fabric or fabrics if two pieces are gigged at one time, thus being made into an endless piece and handled in this manner, the cloth running continuously over the cylinder and through the scray as placed beneath the machine until sufficiently gigged.

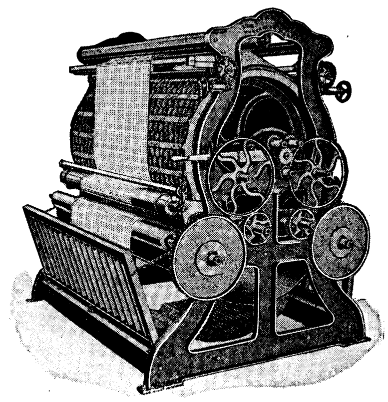


Fig. 17.

The machine has a cylinder, the same as the up and down gigs previously explained, revolving at from 150 to 175 r. p. m., but the cloth, instead of rolling up on drums on top and bottom and getting only one or two contacts in its passage over one side of the cylinder, passes now around the cylinder and gets either one or two contacts on each side of the cylinder, according to the construction of the gig, a machine in the first instance being known as a "Double Acting Gig" and in the latter case as a "Quadruple Acting Gig."

Fig. 17 shows a double acting gig, as built by the Curtis & Marble Machine Co., in its perspective view; at the same time explaining a similar machine as is built by the Parks & Woolson Machine Co. Once the cloth has been started in a rotary gig, the seam only has to be watched in order to tell how many runs the piece has had. The degree of application of the cloth to the cylinder, in these machines is regulated by means of a hand wheel at each side of the machine, said hand wheels operating the contact rolls of the gig. The rotation of the cylinder is reversible, the same being done by means of a cross belt provided to this machine besides the straight belt (the machine having three pulleys, viz.: two loose pulleys—one for each driving belt—and one driving pulley, situated between the two loose pulleys). The cross belt turns the cylinder in the opposite direction from that of the straight belt, the direction of running the cloth being reversed by means of a lever operating a set of gears, which reverse the travel of the cloth. Stretch rolls hold the cloth out to its full width and prevent wrinkles while being gigged, so that it may be left smooth and even for further finishing. The stretch rolls are made with brass trucks and slides, and are a decided improvement over the stretch rolls formerly used, and on which rubber bands were required for holding the wooden slats in place. The draft and friction rolls are driven by a special arrangement of gearing, so that any required tension to the fabric can be maintained uniform on either light or heavy goods, throughout the whole length of the piece.

The goods may be napped in both directions without being taken off the machine by reversing the cylinder and turning over the teasel slats, which are arranged to slide under plates on the cylinder, so that they can be changed quickly. The cylinder is regularly arranged to hold 21 of the common 4½″ slats, or 24 of the 4″ slats, as desired. By having an extra pair of stretch rolls, as each width of the cloth must be stretched from its centre, the machine can be used on 6/4 and 3/4 goods.

When ordered, there is placed a special rotary teasel cleaner beneath the cylinder, consisting of a rotary wire brush which can be lifted up in contact with the points of the teasels by means of a conveniently located hand wheel. The peripheral speed of this wire brush is in the same direction but much faster than that of the cylinder, and consequently frees the teasels from flocks during the operation of actual gigging the cloth and without stopping or reversing the cylinders. This effects a very great saving of time over the old method of cleaning with hand cards or taking out the teasel slats and applying them by hand to a separate rotary brush cylinder cleaning machine.

The Two Cylinder Six Contact Gig. The same is the standard machine with reference to quality and quantity of work done, and is characterized by its smooth and noiseless running, accomplishing, as will be readily understood, more than two rotary gigs could do, permitting contacts and tensions for each cylinder to be adjusted at will while the machine is running; all the operations being accomplished by means of conveniently located handles on the machine. The power is almost wholly transmitted by belts and chain, there being but four gears in all, a feature resulting in a quiet and easy running machine. There are three applications of the cloth to each cylinder and these are independently adjustable while gigging, so that the gig effect for one run, and this for each cylinder, can be regulated to a nicety; however, if it is desired to apply the cloth but twice to each cylinder it can be readily done. The cylinders may be run in the same or reverse directions by the connecting belt being either open or crossed, a tightening pulley mounted on an adjusting quadrant, taking up this belt when it runs open; certainly a handy feature, since it saves splicing the belt when reversing the cylinders. The cloth is carried through the machine by five draft rolls of large diameter, two of which have large plate frictions. The tension of the cloth can thus be adjusted independently for each cylinder according to its work and direction of rotation, and all while the machine is running. On account of the application rolls being covered with brass, the cloth can therefore be left on the machine over night or any length of time without danger of rust marks. A large diameter stretch roll is located in front of each cylinder, making two to the machine, and their stretching capacity is adjustable so they may be set to stretch the fabrics under operation as much or as little as wanted within their range. The cloth feed can be stopped and the cylinders left running by means of a clutch and lever arrangement.

The construction and operation of this machine will be readily understood by reference to Fig. 18, being a side elevation of the Parks & Woolson two cylinder six contact gig, showing the passage of the cloth through the machine by dotted lines. In this machine the cloth having been deposited in the roller scray A, passes from it over guide roll B and draft roll C, and then under stretch roll D, in contact with the first cylinder E of the machine, and where by means of five application rolls, three contacts of the cloth, with the cylinder E are produced. The purpose of the stretch roll D is to free the cloth from wrinkles so that there will be no streaky gigging. Leaving the last application roll, as situated just below the cylinder, the fabrics pass around shaft roll C′ and stretch roll D′ in contact with the second cylinder E′ of the machine, and where by means of five application rolls, again three contacts of the cloth with the cylinder E′ are produced. F and G are guide or carrier rolls, carrying the fabric between the two sections of the machine. Leaving the last application roll in connection with cylinder E′, the cloth passes under draft roll C″, and between it and guide roll H,

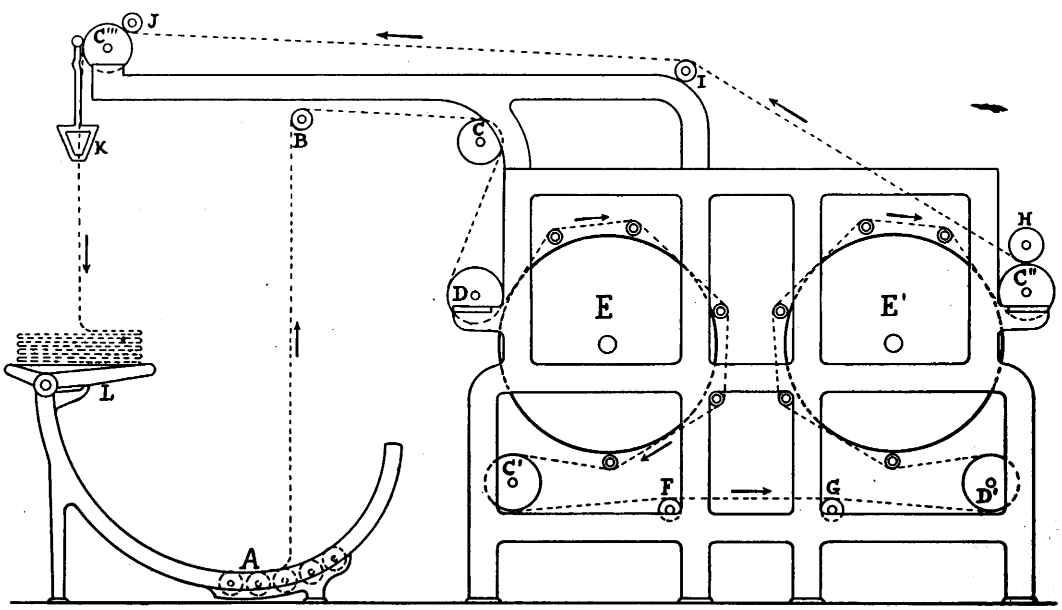


Fig. 18.

over guide roll I, between folder draft roller C‴ and guide roll J, into the folder K, to which, by means of suitable cam and lever arrangement, a to and fro motion is imparted. During gigging, the run of the fabric through the machine is uninterrupted, *i. e.* the number of pieces to be gigged at one time, after having been sewn or wired to each other, and after threaded into the machine, and finally wired or sewn in an endless piece, when leaving the folder K, run back again into the roller scray A and in turn through the machine until their gigging is completed. When this is the case each seam or wire when leaving the folder K, in its turn, is pulled out, tilting table L pushed in position, as shown in illustration, and when the fabric will fold itself on said table. After one fabric is thus folded, it is put on a truck placed handy near the table and the next piece of cloth folded in the same manner.

In this manner we may handle one, two, three or four pieces at one time, either taking them out of the machine at one time, provided they gigged alike, or provided one or the other needs an extra run, this can be readily done by running this particular piece back into the roller scray A and thus again through the machine, taking pieces out of the string, and thus out of the machine, when sufficiently gigged. Previous to the last piece of the string of fabrics taking its last run through the machine, either the first of a new string of fabrics to be gigged or the "apron" is wired to it.

Each cylinder E and E′ has a stationary cleaner brush set beneath it, which are brought into contact with the teasels by hand wheels, with a rack and pinion mechanism. The teasels are thus cleaned quickly, thoroughly, and without doing them harm. A reverse driving pulley is placed inside the regular tight and loose pulleys so the cylinders can be run backward when cleaning. Again, in place of these stationary cleaner brushes, special rotary cleaner brushes can be provided, and which are thrown into their operative positions by separate levers, which at the same time set them to rotating. By letting go of the lever the brush drops away from the teasel cylinder and ceases to revolve. It has adjustable stops and adjustable boxes. The peripheral or surface velocity of these cleaner brushes is in the same direction but greater than that of the cylinders, so that the teasels are perfectly freed from flocks with no injury whatever to themselves. Its advantage over the stationary cleaner is evident at once, since it cleans while gigging and without stopping to reverse the cylinders, and consequently effects a great saving in time and labor.

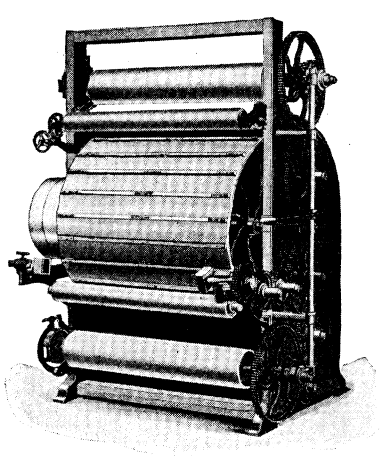


Fig. 19.

Wet Brushing Gig. Gigging done by means of this machine, though termed wet gigging, is really only wet brushing, performed on an up and down single contact gig, using either slats containing old worn out teasels for this purpose, or what is more modern, using in place of it brush lags filled either with stiff bristles or wood fibre. Fig. 19 shows this machine as built by the Curtis & Marble Machine Co., in its perspective view. The purpose of this process of wet gigging, *i. e.* wet brushing is to impart smoothness to the face of the fabric and at the same time create some slight lustre. The supply of water must be plentiful for this process, otherwise the effect aimed at will be lost, and besides unnecessary gig flocks produced. The process is always used in connection with a "face finish," whether the goods are steam lustred or not, also in connection with "burr dyeing" after said procedure. While as a rule used only in connection with face finished fabrics, it also may be employed on close finished fabrics with satisfactory results.

Face Finish. Gigging is one of the most important operations in the finishing of woolen napped goods, for only a well gigged piece of cloth will do justice to the other manipulations of the finishing department, and to properly perform the operation requires years of practical experience. The appearance and, before everything else, the "feel" of the goods, are important guides.

The nap which is required to bring about this finish cannot possibly be formed at the gigs unless there is already in the goods a good, firm, basis on which to work. For this reason the stock, which is put in these goods must possess plenty of the felting property, which makes the production of a good solid felt possible, and when the teasels then can work into this felt without being in danger of cutting down into the threads and consequently weakening the fabric.

A person with any expert knowledge can, of course, readily determine in the case of a finished piece of cloth, whether it has been gigged too much or too little. This, however, is rather difficult during the actual process of wet gigging. Insufficiently gigged cloth, when dry, presents a more or less coarse and unclean appearance and invariably has a more or less raw "feel" when the flat hand is passed downward with the nap, caused by the unloosened felt remaining at the bottom. It is the fundamental principle of correct gigging, to loosen the felt down to the plane of the weave, and to thoroughly lay the nap thus obtained; and the more thoroughly this is done, the finer and smoother will be the surface of the cloth, in appearance as well as in feel. Again the surface of a cloth that has been gigged too much will look indistinct and cloudy, but of course, be very soft in feel.

No definite rules for gigging a face finished fabric can be laid down or learned by rote, still, a few material points useful for beginners may be given. The most important considerations to be taken into account are:

(1) Quality and character of the wool, (2) Texture and weave employed, (3) Kind of fabric under operation and its purpose of wear, (4) The finished effect desired, and (5) The strength of the cloth.

The quality and character of the wool are most important factors, since it will be readily understood, that a cloth made from a fine sound wool will withstand far more gigging than one made from an inferior stock, because upon the fineness of the wool depends its felting capacity, and the finer the wool the more compact the felt, requiring in turn more forcible gigging, in order to produce a smooth and elegant face. The cloth during the gigging has a very soft and open feel, but becomes much firmer and more compact when in a dry state, so that when the piece is dried, an inexperienced person, having previously examined it in the wet state would hardly recognize it. On the other hand, there are wools met with, which increase in resistance during the gigging; they "swell," as the practical finisher says. After the first few runs on the gig they begin to grow thicker and firmer, instead of softening, and when naturally such fabrics demand a forcible gigging. It is not a rare occurrence to find that cloth which has been gigged almost ready in the evening, and has been left lying wet over night, requires the next morning two, three, or even more runs in order to finish it. This "swelling" is a characteristic of the best and finest wools, and may be accepted as an infallible indication of the excellence of the wool used in the construction of the fabric.

The texture of the cloth, especially that of the warp, also demands special attention, since the higher this texture, the slighter is the effect the teasels have upon the cloth and the more it may be gigged without incurring the danger of making it tender. Again the weave, *i. e.* the interlacing of the warp and the filling, and which certainly has some relation with its texture, must also be taken under consideration in gigging. Fabrics interlaced with short, smooth binding weaves, like the plain weave, 4 harness broken twill, 3 harness twill, etc., are not as readily attacked in gigging as pronounced twilled goods, diagonals, etc., *i. e.* looser interlacing weaves of any of the many divisions of weaves.

Fabrics in which the filling forms the face will suffer more than fabrics in which the face is produced by the warp, and in connection with which (filling face cloth) the finisher must exercise the greatest of care, since such fabrics generally require only little gigging and this with dull teasels, whereas goods having their filling well covered by the warp, such as satins, doeskins, kerseys, beavers, etc., require a strong and forcible gigging.

In considering *the desired finishing effect*, it is apparent that a cloth which is to have a fairly long nap, need not be gigged as deeply as one which, if possible, is to be steam-lustred several times, and then shorn short. Melton-like goods require only little superficial gigging, while on the other hand, doeskins, kerseys, beavers and kindred cloths are to be gigged very thoroughly, in view of the subsequent operations. Fabrics destined for wear, like "Uniform-cloths," and in which attention is paid more to their strength than their elegance, gigging must be restricted to its minimum.

In many classes of face finished fabrics, it is necessary to crop down the nap during the gigging process. That is, the piece is taken to the cropping shear and the nap is partially shorn off so that when the goods are run again on the gig, the teasels can get down well into the body of the felt. This more particularly refers to heavy weights. In gigging kerseys for a water finish, it is a good plan to gig very slowly and as much as possible one way only, since these fabrics as a rule are of medium to low grade, and therefore the material used in their construction is usually not of the best felting quality. For this reason make what felt that is there, go as far as possible towards producing a good face, a good plan being to gig them somewhat moister than would be advisable in other cases, since the less moisture the goods have, the easier fibres are pulled out and for the same reason do as little reversing as possible, in order so as not to lose any fibres on that account.

The strength of the cloth is one of the most important points to be considered at gigging, and is frequently the check that retains the finisher from giving a fabric of cloth a workmanlike elegant appearance, however much he may desire to do it, for the fact that a certain strength for it, when finished, is demanded. It is admitted that the finisher cannot impart a good appearance to the cloth without gigging it well, and, of course, deteriorating its strength to a certain extent. To perform this operation successfully, one of two things is necessary—the cloth must either be manufactured from such strong material which, in spite of a sufficient amount of gigging, will remain strong enough to comply with all reasonable demands, or its good appearance must be considered as secondary to its strength. A middle course might, it is true, be followed, and the cloth gigged more and correspondingly longer with dull teasels than with sharper ones. But even in this case success in many instances is uncertain, leaving out of consideration the loss in time and consequent expense to the manufacturer.

The Velvet Finish. This finish, as indicated by its name, shall impart to the face of the fabric a finish having the characteristics of plush or velvet appearance, *i. e.* in that the nap is to be thick, and stand as nearly in an erect position as it can be got. It is a finish relying entirely upon the proper gigging, although a proper cloth structure and proper fulling, previous to gigging, must have been attended to. The stock used in the construction of the fabric should be of good felting capacity, and the fabric handled at the fulling, so as to produce a bottom upon which much work is required. Gig them as moist as possible, but not enough to have them drip, therefore, extract them slightly, to stop the dripping, but no more. When dealing with a double, *i. e.* two cylinder gig, keep both cylinders going in opposite directions all through the process. After gigging is finished, extract and dry them, and give them a thorough dry beating, which will make the nap lofty. All the after processes in connection with this finish must be conducted with care so that at no time there is a tendency to lay the nap much and also to avoid turning it over too much, which is just as bad.

Chinchilla Finish. These fabrics, including Ratine's, Whitney's, etc., also require the greatest of care during the gigging, and as there is much danger of cutting the filling and thus causing streaks, as well as tender goods, it is advisable to keep them as moist as possible during gigging, extracting them only enough to prevent dripping. The common "up and down" single contact gig is a good gig for handling these fabrics, using dull teasels more or less throughout the entire process. Raise a good velvet nap by means of constant reversing. These fabrics are "whipped" just previous to drying on a Rotary Dryer connected if possible directly to the "whipping" machine in order that the nap as erected on the latter machine, is dried before folding the fabric, and thus preserved in this position as much as possible for its clipping at the shear, previous to submitting the fabric to the Chinchilla machine.

Threadbare Finish. This finish, from its name, indicates that the fabric destined for this finish requires its face well "cleaned out," as it is called, quite down to the weave or thread, and for this reason, mainly, it is one of those finishes in which we must be careful not to gig down close at the start. Since this class of goods requires a considerable amount of gigging, see that the cloth is kept well moistened throughout the operation, as a dry thread will cut, *i. e.* get tender much more quickly than a wet one; for the same reason see that the piece comes from the fulling mill in condition for it; however, the real place for laying the foundation for good gigging, *i. e.* a good final finish, is at the loom and not at the fulling mill. The cloth when it comes to the finishing room should be almost heavy enough already, and require but comparatively little felting either way. Scouring, with a very slight fulling, should be all that is required, since it will be readily seen that if a thick, close felt is formed in the fulling mill, it will be almost impossible to gig down to the weave so as to clear out the threads completely, since the thickness of the nap would cover and conceal the threads, and no matter how hard we would try to get down to the bottom with the teasel points, it would be a hopeless task.

Union Cassimere Finish. These fabrics are usually better if gigged dry instead of wet, for the fact that the condition of the cotton in the structure is never bettered by the fabric being allowed to stand about in the wet, for which reason these fabrics are dried just as quickly as possible after the scouring has been done. Gigging dry, certainly has a tendency to harden the goods, but lying about in the wet has a tendency to deaden the colors and make their brilliancy and clearness almost an impossibility, and since it is upon the latter characteristics that this class of fabrics depends for its value, it is best to gig dry, even if it does have a slight effect upon the feel of the goods themselves, since the colors will come up brighter and the general appearance superior. In these fabrics we do not have a thick, close felt to break up, since the fulling is not an important part of the work, and frequently nil, nevertheless, care must be taken not to gig too close on the start or with work which is too sharp for the beginning of the process.

Worsted Finish. A worsted fabric does not require much fulling, frequently none at all, *i. e.* only as much as the fabric may felt during scouring the flannel. All worsted fabrics that are to receive a finish that requires gigging should be taken from the washers to the steaming and stretching or boiling and stretching machine and rolled up to give them a smooth face, free from wrinkles and pits and streaks. They should remain on the rolls from two to three hours. At the gig it is absolutely necessary to begin with "old work." After this "old work" add a few slats of a sharper grade of teasels in the cylinder just before the operation is complete. To obtain the lustre required on worsteds it is necessary to gig all the one way and to use only a fine class of teasels or there is danger of making the goods streaked and consequently unsatisfactory.

The Saxony Finish. This, although more or less a close finish, is not a worsted finish, more closely resembling what we might call a face-finished cassimere. Although some of the nap is left on the face of the fabric, yet the same must lie so that it will be impossible to feel any pronounced spring, at the same time the threads must be more or less visible and not hid by a felt.

NAPPING.

The use of napping machines in the finishing of woolen and worsted goods, has long passed the experimental stage, in fact, they have, for the sake of production as well as a saving in labor, become a necessary adjunct to the finishing room of any mill. It used to be formerly considered an established fact that nothing could successfully take the place of the teasel point, in the gigging (or napping) of face goods, at least; but with the indisputable evidence before us, we must admit that this is no longer wholly true, and undoubtedly there must be some decided point of merit in these machines, otherwise their adoption would not be as universal as it is now; however it is a question if gigging by means of teasels will ever be wholly abandoned, for it must be remembered that the teasel gigs are with us and will continue to be used to quite an extent in connection with certain fabrics.

The Napping machine in itself consists of a series of workers or napping rolls mounted upon a large cylinder, rotating in one direction, while the motion imparted to the individual workers is in the reverse direction. By means of suitably placed application rolls, which can be controlled simultaneously, the contact of the cloth with the wire clothing of the workers is regulated, the production of the machine depending to a considerable extent upon the number of contacts the cloth has with the napping rolls. All nappers are provided with a cleaning device of some kind of construction and which keeps the workers or napping rolls always in the same clean condition, and when therefore each contact of them with the cloth is of uniform efficiency, whereas in connection with teasels, every contact of the cloth with them, reduces their efficiency.

To imitate the teasel point, or at least the elasticity of the teasel point, has been the chief aim of all inventors of napping machinery, and we must acknowledge that most of them have succeeded admirably. They all adopt the metallic point which is rust proof, for which reason the efficiency of the workers is not impaired by moisture as is the case with teasels. Besides being more efficient and uniform in its action, as compared to the gig, the napper does away with the difficult labor of properly setting the teasels into the slats, as well as keeping these slats, *i. e.* teasels, up to their proper point where they ought to be.

Such an absolute uniformity of the working surface as is found in a napper, is certainly never attainable with the teasel, no matter how closely we may watch them and try to keep things as they should be.

The efficiency of the napper being constant and known to the operator, it will be readily seen that any piece of cloth run through the machine will get practically the same amount of gigging as another piece, provided the application of the fabric to the action of the workers is not varied, and the number of runs given, equal to that of the first piece.

On clear face finished fabrics, and where it is an object to clear out the face, and do it quickly, nothing can in any way surpass the efficiency of the napper, for one run over the machine will do more good in the direction of clearing out the face than any number of runs given on a gig. The different speeds at which we are enabled to run the workers of the napper, as well as the goods, and this with the ease with which the contact of the goods with the workers can be regulated, make it possible to produce most any desired finish required by means of the standard makes of nappers in the market. If slow napping is advisable, all we have to do is to reduce the speed of the workers; and if we want to nap fast, we simply have to increase the speed of the workers to the desired point of efficiency.

Another point in favor of the nappers, wherever they are used, is the fact that every fibre pulled from the goods is found right under the machine. Nothing remains in the workers, as there will be on the teasel slats, to be knocked out with the teasels on the refuse heap.

The principle of construction of all nappers to a certain extent is identical, the chief difference being found in their mode of contact, the number of these contacts, and the number of workers. On most of these machines it is necessary for straight work to put on the piece reversed, for as mentioned before, while the cylinder rotates in one direction, the workers rotate in the other, which has a tendency to have the nap in a slightly erect position, leaning somewhat towards the opposite direction in which the cloth travels, and which tendency is increased by means of a stiff wire brush placed at the back of the cylinder, which brush lays the nap in the direction towards which it tends. The cloth is therefore run tail end first for straight work and head end first for reversed work.

On account of the great number of nappers in the market, it would be impossible to describe them all, but as the principle in all of them is practically the same, we will confine ourselves to a description of the more prominent makes only.

Borchers' Eclipse Napper. About 20 years ago napping machinery was introduced into this country from France, the machine then consisting of a series of rollers (workers) arranged in a circle around a common shaft forming a cylinder similar to a teasel drum. The wires of these workers pointed forward or in the same direction as the cylinder revolved, while at the same time each worker turned around its own axis backwards. It is apparent that if the surface speed of the workers around their own axis backwards would be equal to the surface speed of the drum (formed by these workers) forwards, that the workers would roll over, without working, any goods brought in contact with them. Only when the surface speed of these workers backwards became less than that of the drum forwards, could these workers do any work. The difference between these two speeds is called the "energy of the machine" and all napping machines in use to-day are provided with some mechanism by which the speed of the napping rollers can be varied as much as is necessary to produce certain results of naps. In the older napping machines, the goods were brought in contact with the periphery of this drum by being stretched under and over rollers forming tangents to the outer circle of the drum. By this method however the fibre is dragged out parallel to the face of the fabric, and because the rollers or workers are not in constant contact with the fabric, when a worker comes into contact with the fabric it strikes the tightly stretched fabric so hard that it causes the same to vibrate and some of the points of the wire will let go of the thread where they have taken hold and slip over a certain space before they take hold again and thereby produce an uneven nap. To overcome this is the object of the Eclipse Napper as built by R. C. Borchers & Co. In this machine the drum carries around its periphery the napping rolls which are divided into two series, each series comprising every alternate roll, the rolls in one series (and which we will term the outer series) being situated farther from the axis of the drum than the rolls of the other series (and which in turn we will term the inner series). The clothing on the outer series of rolls is arranged to have its wires point in one direction, while the wires on the inner series of rolls point in the opposite direction.

Fig. 20 is a diagrammatic view of a portion of the napper, showing the relation of the rolls, direction of the points of the wire on the rolls, and the cleaning apparatus for the wire. From this illustration it will be seen that the goods to be napped are constantly in contact with the wire points on the rolls. The principle of napping by this machine is based on the relative surface speeds between the cloth under operation, the drum and the napping rolls. Taking the conditions as given in the illustration, with the teeth of the wire on the outer series of rolls pointing in a forward direction with reference to the direction of rotation of the drum, and the direction of axial rotation of the napping rolls opposite to that of the drum, and the cloth being passed in the same direction as said drum revolves, it will be seen that in order to produce any napping by this outer series of napping rolls, the surface speed of the drum must be greater than the surface speed of the napping rolls in relation to their own axes, and the surface speed of the cloth must be less than the difference in speed between said drum and napping roll, in order that the outer surface or point of contact of the napping roll with the cloth should move in a forward direction and at the same time should be faster than the speed of the cloth, in order to have a pull or drag on the fibres with which the points of the teeth come in contact. The main shaft A of the napper, as carrying the drum, has the driving pulley secured to it, while the outer series of napping rolls is driven from the right end and the inner series from the left hand end of the machine, thus allowing the rate of speed of these two series of napping rolls to be varied, independently of each other when required.

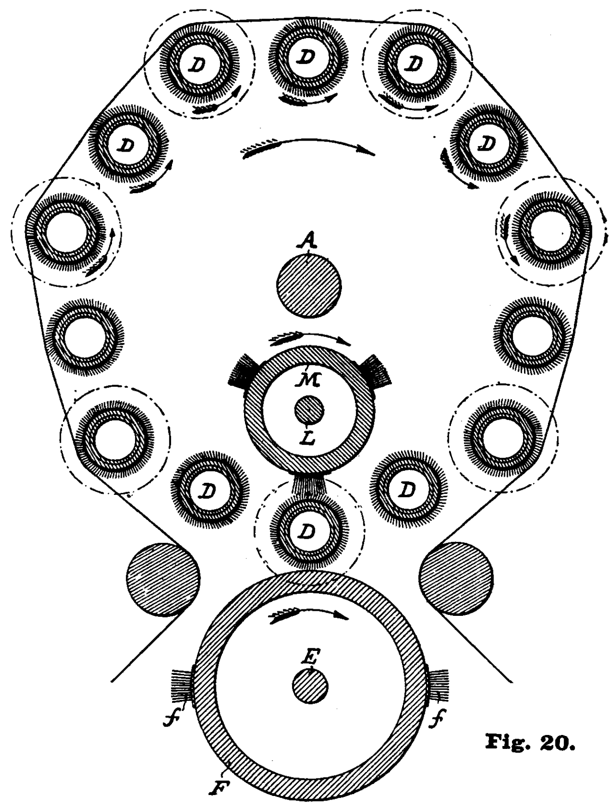


Fig. 20.

From the illustration it will be seen that all of the napping rolls D are rotated in the same direction as indicated by the arrows, but as stated before, by making the surface speed of the outer series of rolls less than the drum, they will revolve in a forward direction, and owing to the direction of its wire points will nap the goods. On the other hand, the series of inner napping rolls are driven more rapidly than the drum, that is, in surface speed, so that the rolls of this series will have a backward motion with relation to the direction of the revolution of the drum, and owing to the direction of its wire points, will also nap the cloth. The relative speed of the napping rollers in this machine is controlled by change gears, thus enabling the machine to always produce the same energy on a certain class of goods.

The cleaning of these two sets of napping rolls is very important and may be done either by putting two cleaners underneath the drum (but by doing this a great deal of working surface of the cylinder is lost), or what is better by placing one cleaner outside and one cleaner inside of the drum, as shown in the illustration, both being positively driven by gears. The outside cleaner is used for the inner series of napping rolls, while the inside cleaner is used for the outer series. For the details of the cleaners we will again refer to the illustration.

Mounted on a shaft E, running from end to end of the machine, is the outside cleaning drum F, corresponding in its length to the napping drum, the greater part of its periphery being free from clothing. At two points opposite each other, it carries a small longitudinal zone of brushing cloth, as is shown by *f* in the illustration. The distance of the shaft E from the axis A of the napping drum is such that when the clothing of the outer series of napping rolls passes the cleaning drum, it is not touched or interfered with by the smooth portion of this cleaning drum, if set properly. On the other hand, the clothing of the zones *f* is long enough to reach to and through the clothing of the inner series of the napping rolls when at its highest point, therefore the rate of revolution of the cleaning drum F, with reference to the drum, is made such that the zones *f*, with their clothing, are presented alternately to each of the inner series of napping rolls as they pass over drum F. This rate of revolution is accurately determined by the number of cogs in the train of gearing, and which cogs must be changed should more zones be used. The inner cleaning drum M, as mounted on shaft L is constructed similarly to the cleaning drum F, part of its periphery being without clothing and having longitudinal zones at equal intervals furnished with clothing, which zones perform the function of cleaning the outer napping rolls with which they come in contact. In the illustration three of these zones are shown, and which number can be varied, but in which case requiring different gearing. As before, the rate of rotation of the cleaning drum M and the position of the clothed zones are such that as the napping rolls of the inner series pass beneath it, the smooth surface of the cleaning drum only is presented, while as the napping rolls of the outer series pass beneath it, a clothed surface is presented and the cleaning function performed.

By reason of there being but one cleaning drum outside of this napping drum, it will be noticed that it is possible to place these napping rolls so near together that out of the fourteen napping rolls shown in the illustration, only one, or at the most two, are ever inactive at a time, thus greatly increasing the production of the machine. These machines are used for any kind of fabric to be napped, wool or cotton, woven or knit.

The American Napping Machine Co.'s Napper. The novelty of construction in this napper consists in providing a skeleton cylinder or rotating head with napping rolls covered with card clothing whose points are all in a backward direction with reference to the direction of movement of the rotating head, and with means for so relatively driving the rolls that one set will act with and the other against the nap, together with means for cleaning the rolls.

Fig. 21 is a sectional elevation of a sufficient part of this napping machine to illustrate its working; showing that the napping head D is mounted upon a shaft C, having its bearings in the two end frames of the machine, and carrying a pulley K.

The napping head D is driven in the direction represented by arrow S in the illustration, from the main driving shaft H by means of belt J passing around pulley I as fast to said main driving shaft H, and the pulley K, previously referred to.

Upon the napping head D are carried a series of napping rolls A, B, provided with card clothing having its teeth inclined in the same backward direction. These rolls may be driven part in one direction and part in the opposite direction, or all may be driven in a backward direction with reference to direction of movement of the rotating head, but at different rates of speed, always, however, so that some of the napping rolls act with the nap and some act against the nap, a feature which is novel in connection with rolls all having teeth inclined in a direction the reverse of the head. The proportion of rolls working with and those working against the nap may be varied as desired, and they may be arranged alternately or otherwise, as the case may require. In our illustration we show the rolls all rotated in a direction the reverse of that in which the head D turns; but the napping rolls A are driven at such a speed in the direction of their arrows in respect to the speed of rotation of the head and travel of the cloth as to effect a picking

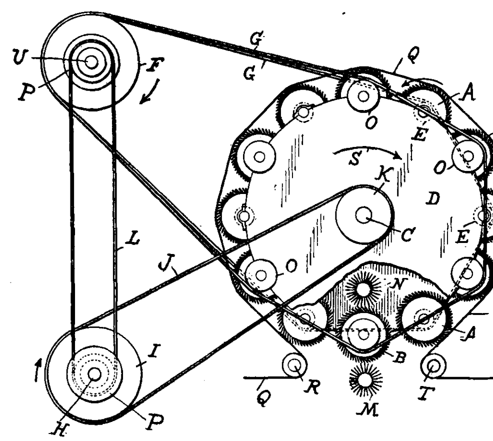


Fig. 21.

action upon the cloth; that is, these rolls travel with the nap, while the rolls B, while turning in the same direction, do not exceed the speed of travel of the head, so that they act against the nap; that is, they travel over the face of the cloth in such a manner as to effect a sort of brushing action, which the builders of the machine claim has been found to impart a better finish to the cloth than would be otherwise secured.

The two series of napping rolls A and B may have the proper movements imparted to them in any desired manner. For instance, the shaft of each roll may be provided with a pulley, the pulleys E on the rolls A being less in diameter than the pulleys O on the rolls B, and a belt G may pass around each series of pulleys from a belt wheel F on a countershaft U, driven from the shaft H by a belt or otherwise. This arrangement, however, is only one means whereby the desired movements may be secured, since the belt L, between the two shafts H and U, may be carried by reverse cone pulleys P, and may be used open or crossed, so as to secure any desired given speed and different directions of movement. Again, the pulleys on the napping rolls may be of the same size, but driven from pulleys of different sizes on the shaft F or from two separate countershafts, thus securing the desired different speed ratios of the napping rolls working with and against the nap.

In order to effectively clean the napping rollers, rollers M, N, are provided, one outside and the other inside the drum, and to which rollers movement is imparted in any suitable manner, each cleaning roll operating on all of the rollers, which is practicable, as the points of the teeth in all of the rollers extend in the same direction. But in case part of the napping rollers are journaled at a greater distance from the drum shaft than the other part, either cleaning device will intersect with but a part of the napper rollers unless there is a difference in their diameters. However, if required, only a single cleaning roll may be used.

The fabric Q, to be napped, enters the machine around guide roll R, from where it passes around the series of napping rolls A, B, leaving the machine again around guide roll T. The speed by which the cloth thus travels around the napping rolls may be varied as well as its direction reversed so as to properly co-operate with the napping head.

The Parks & Woolson Napper. Fig. 22 is a perspective view of this machine from the pulley side, the machine being shown empty. Fig. 23 is a perspective view of the napper from the other side, the machine being shown with the fabric threaded, the roller cloth scray being omitted. Fig. 24 is an end elevation of the main or napping portion of the machine, clearly showing its construction and action, the run of the cloth through the machine being shown by means of dotted line.

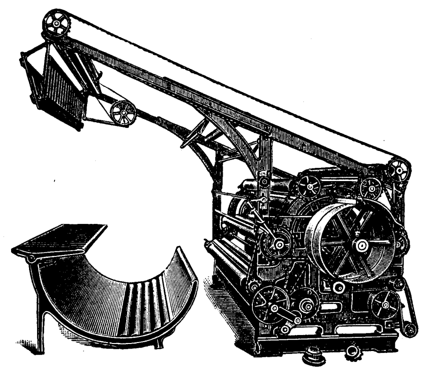


Fig. 22.

The cloth to be napped, after leaving the roller scray, as shown separate in Fig. 22, passes over two guide or idle rolls secured in the framings of the machine, the second one of these rolls only being shown in the diagram of the machine Fig. 24. From this guide roll A, the cloth in turn passes over a tension roll B, around guide rollers C and D, and from there around a stretch roll E. It will be noticed that this stretch roll is of a large diameter, giving a long contact, and consequently exercising a great stretching capacity onto the fabric under operation. This stretch roll is operated by cams, which can be set to give as much or little stretching within their range as may be desired. It operates upon the back of the cloth just before the latter enters upon its first napping contact, presenting the cloth thus to the workers of the cylinder, up to width, smooth and free from wrinkles.

From stretch roll E, the fabric passes next around the first application roll F, and of which there are eight of these rolls used in connection with the machine, in order to produce the four applications—1, 2, 3, 4—between cloth and the workers of the cylinder of the machine. These application rolls are frequently made brass covered, for the purpose of making them rust proof and in turn prevent rust marks on the goods when handling them in a wet condition.

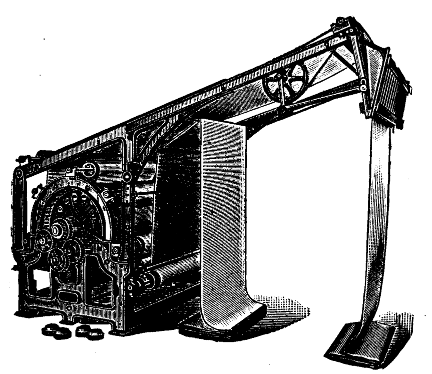


Fig. 23.

On wide machines, and especially for blankets, it is advisable to have these application rolls around the cylinder right and left screw threaded. They are driven by power in the same direction as the cloth, but at a higher peripheral speed than the cloth, for which reason the latter is therefore spread out at each of the four napping contacts 1, 2, 3 and 4, and is thus absolutely held up to width, free from wrinkles, during napping. However where it is difficult, from the nature of the goods, to keep them from narrowing, or the edges from turning, it will be found advisable to use these threaded application rolls, no matter what is the width of the cloth under operation. When the threaded application rolls are used, the stretch roll E can be dispensed with.

G, G′ and G^2 are three draft rolls, made of iron piping, thus are not affected by moisture and which consequently will always run true.

H to H^{15} are sixteen workers as mounted on the cylinder I, which rotates in the direction shown by the large arrow; whereas each one of these sixteen workers rotates in the opposite direction, as shown by small arrows in connection with worker H^6, so that the points of the card clothing on the workers, which point in the same direction as the cylinder speed, rotate fast enough backward to give the proper carding energy to the fabric under operation. This energy is varied by change gears to suit the finish required by the fabric under operation.

J is what is termed the "fancy," it being a rotary wire brush that rotates at a high peripheral speed and in the same direction as the workers. Its purpose is to strip or clean the workers from the flocks, in order that their clothing will be always uniformly effective, and not get filled with flocks. It also aids in brightening and sharpening the wire of the workers, and runs in adjustable boxes.

From the last application roll F^7, the fabric in turn passes from guide roll K, over application rolls L, L′ to guide roll M. Between this course, the fabric is subjected to the action of the brush N, rotating in the direction of arrow, *i. e.* with the run of the fabric, but at a considerably higher speed, in order to lay down the nap on the fabric, and comb the fibres parallel. As will be seen, there are two applications to the brush, the force of which can be readily regulated by means of levers from the outside of the machine during the running of the latter. The brush itself is covered with the best quality of wire clothing, is 16½ inches in diameter, and is positively driven by chain direct from the main shaft, in order to do reliable work, since brushing is a great help to perfect napping.

After leaving guide roll M, the fabric passes over draft roll G^3, as fast to the upper portion of the framing of the machine, and from there over a suitably located guide roll to the draft roll of the folder mechanism of the machine.

The cloth may be of course run through the machine any number of times, either single pieces, or two, three, or more pieces, may be sewn together and napped in an endless chain arrangement. When one or all of the fabrics in the chain have been sufficiently napped, the until now tilted table of the roller scray is raised in position, the seam taken out of the fabric, and the latter made to fold on the table. The width of fold made by the folder can be varied both by adjusting its height above the scray and also changing its stroke.

Characteristic features of this machine are:

(1) It is strongly built, and for which reason it can readily withstand the racking and vibrating stresses of the operation of napping, due to the very nature of the planetary motion of napping machinery. A light napper will soon become shaky and out of line, and consequently will require extra power to

drive it, will not nap even, and require constant re-adjustment and repairs.

(2) The energy, the cloth contacts both on workers and brush, the cloth feed and the cloth tension, are all capable of the widest range or regulation, which renders the machine able to raise the nap on any kind of fabric, from the heaviest beaver to the lightest weight dress goods. The napping is done as uniform on the sides of the cloth as in the middle, and the process does not narrow the fabrics under operation. The machine is positively geared, so that there is no slip possible either in the energy or cloth fed, and for which reason one piece gets exactly the same amount of napping as the next, the same setting of the machine always giving the same result.

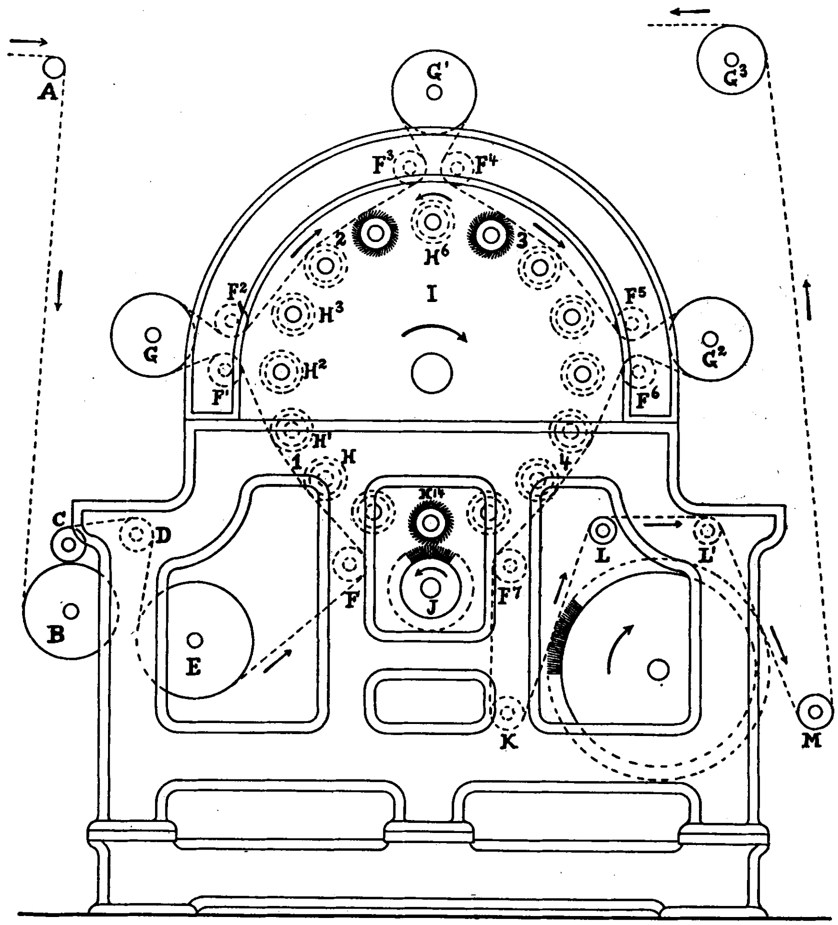


Fig. 24.

(3) A slow speed internal gear encircles and engages the sixteen worker gears on their outside, and runs about one-fifth the speed of an external gear, meshing on the inside of the worker gears. This construction effects a great saving in the power required for running the machine, eliminates vibration and consequently wear on the machine. A sleeve loosely mounted on the cylinder shaft passes through the main box to connect the internal gear with the energy change gearing, an arrangement which gives a stiff setting and long bearing, and steadies the planetary motion, and makes it run smoothly and evenly, a feature which naturally considerably prolongs the life of the machine.

(4) The relative speed of the workers around their own axes and around the drum axis is governed by a train of gears on the left end of the machine beneath the gear guard. These gears are rigidly mounted on studs set directly into the frame. The change gear is set on the end of the main shaft and is connected with the train by an intermediate gear on a swinging arm with a screw adjustment, for which reason a change in the energy of the machine is quickly and easily made. The range of the energies is divided into fine gradations, and for which reason you never have too low an energy because the next one above is too high.

(5) The cloth feed is positive, chain and gear driven, and can be varied between ten and twenty yards per minute by means of quick change gears, a feature which permits the use of the highest possible energies by speeding up the cloth. Frequently it will be found that with advantage the cloth speed can be increased, instead of reducing the energy, a feature which often is the case in the last run or runs of the piece on the machine, and when besides accomplishing the same result with reference to napping, you at the same time increase the output of the machine.

(6) The four cloth contacts with the workers are operated simultaneously by one hand wheel conveniently located outside the machine, and which is operated while the machine is running, permitting any degree of contact required, instantly and uniformly to each of the four contacts in the machine by one movement. A graduated dial with indicator gives the exact setting, and consequently accurate records of this, with reference to a certain finish, can be made and readily duplicated any time.

(7) The worker bearings are self oiling, the cylinder heads being for this purpose made hollow and used as oil chambers, automatically supplying each worker bearing with oil.

(8) With reference to napper clothing, for wet work, what is termed "bronze clothing" and which is perfectly rust proof is used, and which varies in fineness; selecting the required grade of it with reference to the average work to be done by the machine, *i. e.* where coarser goods are used, select a heavier clothing, whereas for finer goods, a finer grade will be advisable. For dry napping, steel clothing is good enough.

The Parks & Woolson Machine Co. also builds a napper which they call their "Cotton Napper," but which is so closely related to the construction of their woolen napper thus described, that no special reference to this machine is required, the main difference being that in this cotton napper there are four or five shorter applications of the cloth to the workers, that the application rolls are of steel only in place of brass covered, and that a stationary hot ironing roll with steam connections is provided, over which the cloth runs before it reaches the napping rolls.

Method of Clothing the Rollers of Nappers. The object is to clothe the napping rollers with card clothing, so that said clothing is wound spirally and oppositely on each side of the central transverse plane of the roller, and this in such a manner that any uncovered space extending circumferentially may be avoided, thus preventing wrinkles in the cloth when treated by napping rollers thus clothed.

The reason for having one-half of the card clothing wound spirally in one direction and moving toward the nearest end, with the other half of the roll wound oppositely, is to keep the fabric, which is passed over it, extended in its full width.

The improvement more particularly consists in a specially shaped tongue of card clothing which is used at the central portion of the circumference of the roll, as a start for each oppositely disposed strip of card clothing. The shape of the tongue is shown in Fig. 25, which is a diagram showing the tongue lying straight. From this diagram it will be noticed that the tongue is V-shaped, the small end having a hole 1 for the insertion of a screw, while the other end is made with ears or ends 2 and 3, with a converging space 4 between said ears, corresponding in size and outline to the opposite or small end of the tongue, since when placed on the roll, the small end will fit into said space 4. Each ear 2 and 3 is provided with holes 5 and 6, respectively, for having buckles attached to them, the other portion of said buckles being attached to the respective ends of the strips of card clothing which are to be placed on the roller.

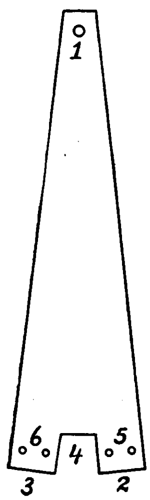


Fig. 25.

When covering a roll, the tongue is first secured to it by its small end with a screw in the hole 1, then the tongue is wrapped around the roll, the buckles having previously been attached, so that the ends of the card clothing may be secured to the ears 2 and 3. The clothing is then put on the roll in the usual manner.

Although there are no wire teeth at the places occupied by the buckles and hole, yet this space is so small as not to affect the proper working capacity of the rolls thus clothed. This mode of clothing the rollers of nappers is the invention of David Gessner, Worcester, Mass.

Roy's Grinder for Napper Rolls. The old way of trying to grind napper rolls by running them together is becoming obsolete. They are now run together only to burnish them after being ground. They cannot be ground true and with a proper point without a traverse grinder fitted with two wheels—one an iron wheel covered with emery (about No. 8) same as is used for card grinding—for surface grinding, and the other wheel made up of a number of thin emery wheels or "saws," usually from 10 to 15 in number and about $\frac{1}{16}''$ thick, for side grinding the wire.

The frame, in which this grinder runs, must be heavy and rigid and made with bearings, for the napper rolls, which are adjustable to the grinder and also adjustable for shafts of different diameters. The latest style machines are constructed so that while two rolls are being ground, two pairs of rolls are run "back to back" (after being surface and side ground) to burnish them, all six rolls running at the same time on the one grinding machine.

Fig. 26 shows a machine of this type, as built by B. S. Roy & Son, in its perspective view, clearly showing that two rolls can be ground at the same time in the two upper bearings, and, while these are being ground, two pairs of rolls which have already been surface and side ground, can then be run "back to back" in the four lower bearings. All rollers are thus first surface ground with the iron wheel in order to true them, then side ground with the disc wheel, and then run "back to back" to burnish them.

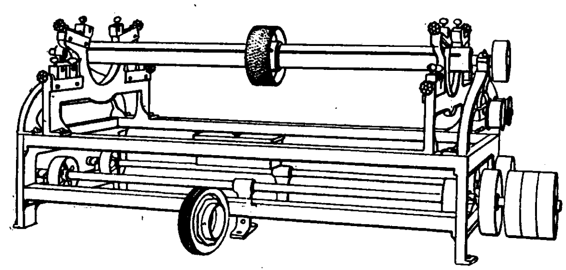


Fig. 26.

As napper rolls are very wide—72″, 80″ and wider—it is absolutely necessary that the traverse grinder should be very rigid and true. Nothing smaller than a 5″ steel shell should be used. With a machine of the style shown in the illustration, different widths of napper rolls can be ground on the same machine as the heads are adjustable to any width narrower than the full width of the machine, a feature especially useful where more than one width of nappers are used.

STEAM LUSTRING.

This process has of late come into general use in connection with the wet finishing of Kerseys, Beavers, Broadcloth, Thibets, Venetians, Tricots, Plushes, Uniform-cloth, etc., also for setting Worsteds and freeing them from wrinkles; the time that in connection with face finished woolen goods a common water finish would pass inspection, having gone by, nowadays nothing but a thorough steam finish will satisfy the buyer.

The best cloths to take a lustre are made of fine short staple wools, long naps well brushed, so the fibres all lay flat and straight, giving the highest lustres. For short naps a five leaf satin or four harness broken twill, warp effect, a five or seven harness corkscrew are weaves giving the best lustre. As a rule, the wetter the gigging, the better the lustre.

The old boiling process, as used in years gone by so extensively, in order to produce a highly finished and lustred fabric, although excellent in its ultimate results, fell short of giving production; hence special machinery had to be designed for doing the work equally as well, and at the same time give the so much desired large production by manufacturers; the boiling process only being practiced yet in few mills, and this only where help is cheap. However for the fact, that boiling is still used in some mills, and that it was the foundation for the modern steam lustring machine, a short description of the process will greatly assist in understanding the object of the latter machine.

In the boiling process, the goods after proper gigging and also a thorough wet brushing, on the wet brushing gig (see Fig. 19, page. 324), are tightly wound on wooden rolls at the latter machine, a burlap or canvas cover being then wound around this roll of cloth and the ends tied. A number of these rolls of cloth thus prepared, are then placed by means of the protruding ends of the wooden rolls, in framings in a tank, arranged in such a manner, that the cloth of one roll will not come in contact with that of another roll nor with the sides of the tank. Two or more tiers of rolls of cloth are thus placed in one tank. After the tank is filled with rolls of cloth, water and steam are turned on, so that by the time the tank is filled with water, the same will be quite warm. The tank is then covered and the water allowed to boil, and kept at a moderate boil as regulated by the amount of finish required by the goods, on an average for from four to six hours, care being taken to keep the goods during the process always under water.

The hot water is then drawn off and replaced with cold water and the goods allowed to cool in this for from two to three hours, after which the water is drawn off and the rolls of cloth taken out and sent again to the wet brushing-gig and subjected to another thorough wet brushing, after which they are rolled up again on the wooden rolls for another boiling, but being this time rolled in the reverse way from before, in order to subject both ends of the cloth to the same amount of boiling. These two boilings, as thus referred to, go hand in hand, they form one process, which must be repeated, provided one process should not be sufficient for a certain finish required, giving a thorough wet brushing each time the goods are intended to go to the tank. Goods treated in the manner described, will acquire a finish which is lasting, since the heat is slow and gradual, permeating the whole piece evenly, and by reason of slow boiling, the finish becomes set in such a way that it cannot be easily destroyed. However, it was and is too slow a process for large production in a mill, a most important item nowadays.

The first machine to take the place of the boiling process was *the upright steamer*, which may yet be found in many mills. The object of this process is to force steam through the cloth for a certain length of time, and then cold water, until the goods are well cooled. While the action of the steam upon the wool fibre will bring out the inherent lustre of the fibres, one would think that this would be sufficient for the process of steam lustring a fabric, however it is the action of cold water which tends to set the lustre which has been obtained by means of the steam passing through the goods. Besides this, as soon as the steam passes through the goods, a great many impurities, adhering to the structure of the fabric, will thus be loosened and which will be carried off by the water, thus leaving the fabric in a practically cleaner condition than when it went on the machine.

This upright steamer consists of an upright frame with projecting arms at the top and bottom into the sockets of which a perforated roll, upon which the cloth to be steamed has been previously wound, can be set and firmly locked in place. An arrangement of pipes connects the top and bottom end of this perforated roll, with pipes through which either steam or cold water can be introduced, and in turn forced through the cloth, the amount of either, being regulated by suitably located valves. After winding the fabrics tightly on these perforated rolls, previously to steaming them, a covering, the same as was used in connection with the boiling process, is wound around every roll of cloth, said covering however, being this time about two feet wider than the fabrics under operation, and of sufficient length to cover the roll of cloth at least with three thicknesses. After this cover is wound around the roll of cloth, its overlapping ends are fastened down on the roll by a strip of cotton cloth run spirally around the roll, being finally securely fastened, in order to prevent the covering from flopping when the force of the steam comes through the roll of cloth. After this has been done, and the roll placed in the sockets of the projecting arms of the steamer, then steam is turned on and allowed to penetrate the cloth until appearing evenly on the outside of the covering. How long to keep up this process is regulated by the kind of fabric under operation, *i. e.* finish required, say about five minutes for a fair average time after the steam appears evenly on the covering. After then turning off the steam, the water valves are opened and a powerful stream of water thus forced through the roll of goods until they are thoroughly cold, in some mills a special force pump being used for this purpose. After the goods are thus cooled and the water turned off, the roll is then taken from the steamer, back to the wet brushing-gig, unrolled, and given a good wet brushing, after which the process of rolling, steaming and cooling the fabric is repeated, but winding on in this instance the other end of the fabric first, or next to the perforated roll, in order to have the finish uniform throughout the fabric. The number of these steamings with its respective windings on the perforated roll, cooling, unwinding and wet brushing may also be repeated, taking the strength of the fabric and the finish required for it under proper consideration.

However when we take into consideration this amount of labor required in winding and unwinding the cloth onto and from its perforated rolls respectively, and more particularly in being compelled to cart the goods between the operations, back and forth to the wet brushing-gig, it is no wonder that manufacturers looked anxiously for the introduction of a machine to do away with this waste of labor, and it was then that

The Steam Gig made its appearance amongst wet finishing machinery in woolen mills. The same is still in use in mills, and practically resembles, or is an up and down gig, the only difference being that its cloth rolls at the top and bottom are hollow, perforated, copper drums, the lower one being set into a trough the same as at the wet brushing-gig, both the top and bottom rolls being suitably connected with steam and water pipes.

Fig. 27 shows the steam gig as built by the Curtis & Marble Machine Co. in its perspective view. The advantage of the steam gig over the old fashioned boiling process or the upright steamer consists in the fact that the goods do not leave the gig until the steaming and wet brushing processes are both completed, a feature which naturally results in a considerable saving in time and labor. Both ends of the fabric under operation at the steam gig, are supplied with a canvas apron, projecting on each side about one foot outside the width of the fabric under treatment, and of a sufficient length, to permit proper handling of the fabric on the machine. In running the cloth first on the perforated top roll, proper care must be exercised so that the fabric runs on smoothly and evenly and at the same time under as much tension as possible. When the fabric is wound on this roll, its apron is then fastened to the bottom roll and the goods started to run under a strong tension downward and wind on the bottom roll as is revolving in water, supplied to the tank through the bottom roll and its connections. The cylinders of these gigs are also—if so required—clothed with stiff wood fibre brushes, in place of using slats containing old, *i. e.* more or less worn out teasels.

Next the fabric is run again on the top roll, the apron in turn liberated from the bottom roller, run around the roll of cloth and secured to it similar as was explained in connection with the upright steamer. When this is done, open the water valve for the top roll and close the one for the bottom roll. When the water is seen to come evenly through the roll of cloth, turn its supply off and admit steam the same as explained in connection with the upright steamer, then cool again with water, run fabric on lower roller, covering it in turn with the other apron, and steam the roll of cloth at once. During running the fabric from one cloth roll to the other, the same receives a good wet brushing by the stiff wood fibre brushes the cylinder of the machine is clothed with. A good strong tension during the winding, and a perfect even winding as well as a thorough cooling by water after steaming, are absolute requirements for the process, otherwise cloudy goods will result.

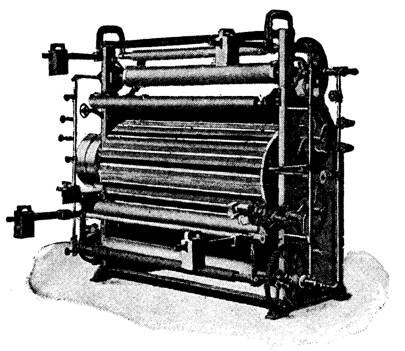


Fig. 27.

The Steam Lustring Machine. However the hollow, perforated, rolls of the gig, and on which the rolls of cloth were steamed, are frequently found to be too small for large production, and since on account of lack of room on the gig they cannot be made much larger than 7 inches, the demand for an increased production soon led to the building of the modern steam lustring machine. It was soon seen that there was quite a chance to increase the capacity of the machine, and while the first machines of this kind were built with 7 inch cylinder, it did not take long before the at present used 18 inch cylinders were introduced, and where it formerly took about 22 inches of cloth to go around the roll of the steam gig it now takes about 56½ inches to go around one of the cylinders of the modern steam lustring machine, certainly a feature which makes it plain that much more cloth can be steamed at a given time with this machine as compared to the steam gig. Again the cylinders being so much larger, they in turn give more chance for a good head of steam to do its work, and therefore we must carefully look after these cylinders in this machine to see that they are in the proper condition, else steam is sure to be wasted, and in consequence production reduced.

The principle of steam lustring by means of this machine remains the same, and for all practical purposes the work is in a measure identical with that of the steam gig, as previously described, but on account of the improvements made, it is possible to handle more pieces of cloth at a given time than can be done on the steam gig.

With a machine of this kind and large capacity of fabrics it has to continually handle, it is reasonable that extra precautions should be taken to insure the best results, and for which reason a few practical points on "how to handle the machine as well as the fabric during the process" will not be amiss. After carefully leveling the machine so that the two hollow, perforated, copper cloth steaming cylinders will run free, and, with the clutches out, can be turned freely by hand, pipe steam and cold water into the tees in the overhead pipes, both front and back, using one inch pipe for steam into the smaller openings, and one and one-half inch pipe for water into the larger openings. The valves controlling the steam and water supply should be placed near the tees so they can be handled from the same position as the valves on the machine. The pressure of the steam is not important, as it can be regulated by the inlet valve. It is well, however, to have it fairly even, so that uniform finishing will result, ordinary mill pressures of fifty to seventy-five pounds being about right. Each of the two cylinders is set in a tank, supplied with drain pipes to take care of the surplus water.

The driving belt for the machine should be a three and three-quarter inches wide, mineral tanned leather belt, which will withstand the steam and moisture better than a common leather belt.

The two cylinders are each seventy-four inches long to the outside of the end collars, and since it is necessary to allow at least four or five inches at each end to tie in the bag, it would not be convenient to steam cloth on the regular machine over sixty-five inches wide or thereabouts; however special wide machines, for wider fabrics are also built. The perforated length of the cylinders is fifty-four inches in the regular machine. These perforations should not come inside of four inches from the end of the cloth when it is wound onto the cylinders, and two inches is better. When there is a wide variation in the widths of cloth to be steamed in a mill, the perforations should be made right for the widest goods. If they then extend outside of the narrowest goods, the tying in of the bag at each end will confine the steam to its work. Cloth can be rolled onto the cylinders up to thirty-six inches in diameter, more than this will result in imperfect work, since it is not practical to steam through a greater thickness. The cylinders should be wound about once and one-half around with clean, smooth burlap, of which it will take about two and one-half yards, seventy-two inches wide, to each cylinder. Wet it thoroughly in warm water to soften it. Smooth it out carefully when laying it on, rubbing it back by hand. The outside end should be straight, and sewed flat to the layer beneath. Wind tightly with common cotton twine for about six inches close to the end, leaving a tying end exposed, then diagonally three inches between threads to the other end of the cylinder, where another six inches in width is wound closely. Return diagonally across to the first end and tie down with the tying-end. This will bind down the burlap so the steam pressure will not bulge out the middle and pull the ends inward. Cover this over with about six layers of cotton sheeting of medium weight. Wet it as before, and start the end at the seam just made. Smooth it with care. Sew it down about two feet from the end, leaving a loose flap. About twenty yards in all of seventy-two inch sheeting will be needed. These burlap and sheeting jackets should be kept clean by frequent soaping on the outside, and running steam and water through from the inside. They will become dirty, however, even with these precautions, and will have to be occasionally taken off for separate cleansing by running through the washers. Whenever they become stiff to the touch, it shows the pores are full of dirt, and they should be washed.

From three to six pieces may be steamed at once, according to the style and weight of the goods, and the finish required. A few trials will readily show the number of pieces to give the best results on any particular style. The pieces to be steamed together should be sewed one to the other with the nap of each on the same side and pointing in the same direction. A leader should be sewed to each outer end. The sewings should be as flat, smooth, and even as possible to prevent marking the goods, a mill sewing machine being the most desirable for this purpose. The leader or apron should be of good, smooth ticking, twenty-four to thirty-six inches wider than the goods, so that the end of the completed roll on the cylinder can be well wrapped down. In length said leader should reach once around one of the copper cylinders, and to a good distance beyond the brush, so that when the cloth is started, no part of the fabric will remain unbrushed, about five or six yards to a leader being sufficient.

In order to give a clear understanding of the construction and operation of this machine, as well as the process of steam lustring, the accompanying two illustrations are given, and of which Fig. 28 is a perspective view of the machine as built by the Parks & Woolson Machine Co., and Fig. 29 an end elevation, in outline, of it.

The cloth is commonly run into the machine from a truck set in front, and is first threaded through the "tension bars" and wound onto the "loading drum," with the face toward the operator, and the nap pointing upward. Care should be used to get an evenly ended roll. The leader is then threaded over the "front break roll," under the "front stretch roll," over the two "brush application rolls," under the "back stretch roll," over the "back break roll," and under the "back cylinder" on the inner side. The leader should be laid around the cylinder with the sheeting flap over its end, the whole being neatly smoothed out. Usually the brush applications are put on to give the most brushing possible.

The back cylinder may now be started. The amount of friction to be applied to the loading drum must be found by experiment. When the friction is once set, however, it can be thrown out and in, giving the same tension every time. A hard and compact roll is wanted, but not so hard that the weave of the fabric will be imprinted on the face of the goods, or the sewings leave their mark. A little time given to the first setting of the frictions will make the machine turn out faultless work. A six inch heading of cloth, similar to that being steamed, can be laid on the back of each of the sewings as fast as they appear. By the "back of the sewing" is meant the side showing the raw ends of the pieces sewed together. The heading will, therefore, be wound in under or over the sewing according to which side of the seam these raw ends appear. Winding in these headings over the sewings will absolutely prevent their pressing creases in the goods. There should be no touching or handling of the cloth whatever between the brush and the cylinder, so that it will be entirely free from all marks that might be set in steaming.

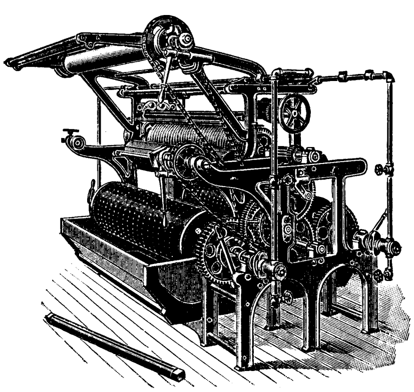


Fig. 28.

When the outer leader has been laid smoothly around the cloth on the cylinder, it should be tightly wound with cotton duck tape about four inches wide, and which is especially manufactured for covering these rolls, and can be bought of any supply house. In winding on this tape, catch the end under the first turn, beginning at one end on the loose part of the leader outside of the cloth. Wrap the end well in, then wind across the cylinder, bringing the sides of the tape evenly together, but not lapping them. If it is lapped, it is liable to print on the cloth beneath, and also to slip sideways when the steam is turned on. Finish the other end the same as the first, drawing up the end of the tape under the last turn. This will form a bag to confine the steam properly. All leakage from this bag not only means loss in coal, but also loss in the time of steaming; it should, therefore, be tight and well made. It is the practice in some mills to wind the tape on an empty winding roll in the winding attachment, keeping a roll for that purpose. In this case a winding attachment on both sides of the machine is required, which in turn enables the operator to make the bag perfectly in a much shorter time.

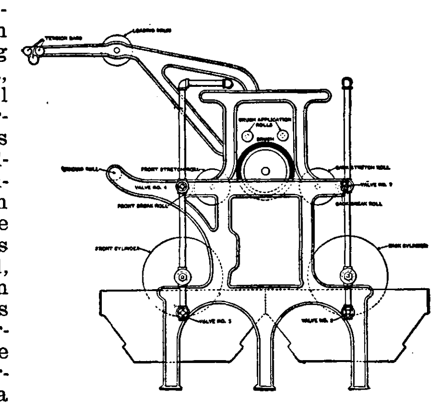


Fig. 29.

The cold water should be turned on for wetting while the cylinder is revolving. Open valve 1, so the water will run in at both ends and see that valve 2 is shut, to prevent waste. When the water appears uniformly all over the bag, turn it off. The water should now be blown out of the cylinder. Shut valve 1, open valve 2, and turn the steam on gradually, meanwhile keeping the cylinder revolving to prevent the water settling and clouding the goods. When the water is about blown out of the cylinder, which can be told by the sound after a little experience, shut valve 2, and open valve 1.

In timing the steaming, figure from the time the steam appears uniformly on the outside. The duration of the steaming must be determined by actual experiment. It differs according to the pressure of the steam, the quality of the goods, and the finish required. Practice varies in every mill.

Goods that have been steamed will dye about two shades darker than if not steamed. In general, low grade cloths, light weights and dress goods are steamed a comparatively short time, say five to twenty-five minutes. High priced goods and heavy weights should be steamed longer—anywhere from twenty to sixty minutes, and sometimes more than an hour. Any fabric over twenty ounces takes at least a half to three-quarters of an hour for the process. Be careful not to steam low grade goods too long, lest they be made stiff and tender. Too much steaming of any cloth will make it tender, and too little will not give a permanent lustre. The longer the steaming, the more the strength and elasticity of the cloth will be reduced. For dull finishes, the steam may generally be turned off as soon as it begins to come through the bag.

After the steam has been shut off, close valve 1, open valve 2, and let in the water for cooling very slowly. The cylinder is now full of steam, and if suddenly condensed, the partial vacuum thus formed will bring too great a pressure from the outside air, and a collapse of the cylinder will follow. The opening of valve 2 acts as a safety valve. When a few seconds have been given the steam to condense, shut valve 2 and open valve 1, so the water will be admitted at both ends of the cylinder. The cylinder must be revolving all the time to give quick and even results. The water should be kept turned on until the roll is thoroughly cool all over the outside. This can only be tested by touching with the hand. When uniformly cool, turn off the water, leaving valves 1 and 2 just as they are, open and closed respectively, and ready for the next set of pieces.

The tape should now be unwound, the leader threaded over the break and brush rolls, under the stretch rolls, and under the "front cylinder" on the inner side. The wrapping tape should be wound off on a roll, so it will be left in convenient shape.

The same process of rolling, wetting, steaming, and cooling as just explained are now repeated; and when valves 4 and 3 in connection with the front section of the machine, equal valves 1 and 2 respectively of the back section of the machine, and in turn are operated upon correspondingly as explained.

The cloth should now be wound off directly onto a wood roll set in the "winding attachment" in front, first removing the leader, as it should not be wound in. Start the end of the cloth straight, and see that it lays perfectly flat around the roll. The other leader should also be removed, as a much shorter outside wrapper can take its place. This should be bound well at the ends and middle. Headings, as are cut off from the finished fabrics before rolling them for the market, are good for this purpose.

While steaming on the back cylinder, cloth may be wound onto the loading drum or winding attachment, and, while steaming on the front cylinder, the cloth may be wound onto the back cylinder. During these several winding and steaming operations, there is also ample time to get new pieces, make the sewings, and take away the finished rolls. Thus it will be seen that the machine is designed to be operated in a double and at the same time continuous manner, a feature which cannot help but result in a large production.

After removing the roll from the winding attachment, it is generally stood on end until the next morning. The best length of time to let it stand should be ascertained by a few trials. The longer it stands, the more it will lose in elasticity and strength, especially the former. Pieces steamed in the white that are to be dyed in light shades, should be left on the rolls the same length of time. A variation of two or three hours might not be noticeable, but it will be found that the longer the cloth remains on the rolls, the darker the resulting shades. For dark colors, little care is needed in this particular. Piece dyes should be turned end for end, so they will stand about the same time on each end. Wool dyes will not need to be reversed.

Some mills boil the cloth while steaming, by filling the drip pans with boiling water. The steam and water pipes necessary for this purpose can be easily put in by the user with no alteration in the machine. Boiling alone will not give a lustre so high nor so quickly as steaming, besides more or less unevenness is common to the boiling process.

The brush is clothed with stiff wood fibre in order to lay the nap well, being for this reason also run at a high rate of surface speed.

For handling worsteds, and where the machine is more particularly used for setting them and freeing them from wrinkles, the brush, together with its application roll mechanism, is not needed.

TENTERING AND DRYING.

After the cloth has been washed, gigged, napped, steam lustred or in other words passed through any of the processes of wet finishing required to be given to it in order to obtain the proper final finish for it later on, it must then be dried, so as to be able to handle the fabric afterwards in the dry finishing department. During this drying, the fabric under operation must be somewhat stretched in length and width in order to keep them smooth for the operations of shearing, etc., as performed afterwards. When this precaution of maintaining this smoothness at the drying machine is neglected, then the after processes will act upon the cloth in such a way so as to make all uneven places and creases in the fabric past remedying, a feature which by previously keeping the cloth properly stretched during drying, cannot occur. This tentering and drying of the cloth is done on what is known as a Return Tentering and Drying Machine, and of which two specimens of makes are given, viz.: the machines as are built for this purpose by D. R. Kenyon & Son, and the H. W. Butterworth & Sons Co.

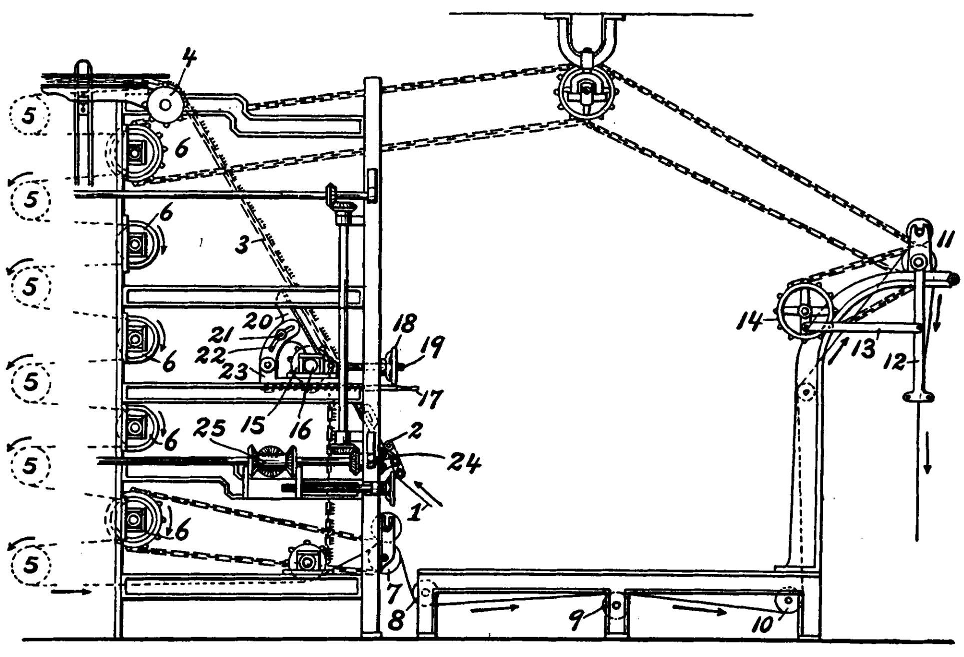


Fig. 30.

Fig. 30 refers to the machine as built by D. R. Kenyon & Son, the illustration being a partial side elevation of this machine, showing the feeding and delivering mechanisms, and also indicating the passage of the cloth through the machine.

This machine is designed on the pipe system of drying and is characterized chiefly by the arrangement for feeding the cloth to and delivering it from the machine, said feeding arrangement being known as the "low-down feed," from the fact that it is located near the bottom of the machine, and which thus enables the operator to attend to the feeding from the floor, instead of having to work on an elevated platform, as in the case of overhead feeds. This "low-down feed" is one of the most important improvements ever made on this machine, all other machines with low-down feed, as claimed by the builders of this machine, being copied from it.

Referring to the illustration, the wet cloth 1 as coming from the steam lustring machine, gig, napper, washer, as the case may be, according to fabric under operation, is deposited in a folded condition on the low platform at the front of the machine, and from where it passes, in the direction of the arrow 1, to the machine, under tension rolls 2, from whence it passes in an upward inclined direction until it is caught, by its selvages, upon the pins of the cloth carrying or gill chains 3, there being one for each side of the cloth. Each respective chain passes over a sprocket wheel 4 and thence through the drying machine, back and forth, around the rolls 5 and 6, said rolls 5 being located at the rear end of the machine, although for convenience, they are shown close to the front series of rolls 6 in the illustration.

The steam pipes for drying are formed in coils and arranged in tiers in the spaces between the passages of the cloth, from the front rolls to the rear rolls and vice versa. The cloth in thus passing under tension, warp and filling ways, between these series of steam pipes, several times throughout the full length of the drying chamber, is thus thoroughly dried and tentered to the proper width. The path of the cloth through the drier is indicated by broken dotted lines, and after leaving the bottom roll of the series 5, said cloth passes to a guide roll 7, and from there successively under a guide roll 8, over a guide roll 9, under another guide roll 10, then up to the delivery rolls 11, situated above the folding mechanism 12. (Guide rolls 8, 9 and 10, are below the platform from which the wet cloth is fed to the machine and upon which the operator of the machine—more or less—stands, the return of the cloth from the machine thus being out of the way of the operator.) After passing the delivery rolls, the cloth is folded by passing down between two horizontal rods of the folder 12, to which is given a vibratory motion through an arm 13 and sprocket 14 to which the latter is attached.

In order to accommodate different widths of fabrics fed, each sprocket wheel 15 (one on each side of the machine), as secured to the shaft 16, and over which each respective chain 3 passes, is made movable laterally by a lever 17, and the whole arrangement on each side is made movable forward and backward through a hand wheel 18 on a screw rod 19, one for each side, said screw rods being attached at one end to the bearings of the shaft 16. An inclined frame 20, is also mounted on the shaft 16, on each side of the machine and serves to support its respective gill chain at the point where the cloth is first secured upon their pins. Its angular position may be adjusted when desired, by changing the position of the bolt 21 in the slot 22 of the curved arm 23, on each side of the machine.

The machine is made in different styles, of various lengths and widths, according to the amount of cloth to be dried, and from six to ten feet in height.

By having the low-down feed, the operator is enabled to occupy a position very near the floor, and at the same time properly attend to both the feeding of the wet cloth into the machine and the delivery of the dry cloth therefrom. The operator thus, while receiving the dry cloth, always has the feeding-in devices under his eye and can see that they are operating properly, and also he can at any time promptly adjust the chains to suit varying widths of cloth, without leaving his position. The whole machine can be widened or narrowed from 27″ to 65″ by means of right and left hand screws, which move the screw bars to which are attached the chain guides and sprocket wheels. These screws are operated by means of worm wheels and worms, the latter of which are attached to shafts 24 which can be moved either by power or hand. When run by power, the bevel gear mechanism 25 is used, and if turned by hand, it is operated by means of handle attached to lower shaft 24. Machines are also made to take goods up to 100″ in width.

Fig. 31 shows in its perspective view (complete) the Return Tentering and Drying machine as built by the H. W. Butterworth & Sons Company.

These machines are of very substantial construction and will deliver the cloth uniform in width, with straight and even selvages.

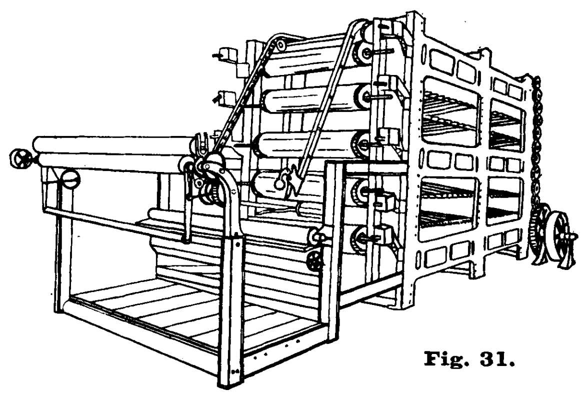


Fig. 31.

Special attention is called in this machine to the patent bearings for automatically taking up the slackness of chains.

They are made in any number of sizes, same being adapted to the production desired by the manufacturer.

SHEARING.

The object of this operation is to level the nap, as previously raised by means of gigging, napping or brushing, on the fabrics, and which nap or pile is, of course, more or less irregular in length and has to be sheared off level to different lengths in different fabrics, to permit a certain finish required by the particular fabric under operation to be produced. In some instances the nap or pile is completely sheared off, in order to produce a "clear face," or "threadbare" finish on the fabric, and in which instance the interlacing of the threads as producing the weave or pattern is clearly shown; in other instances a short nap is left, standing more or less erect, on the fabric, to produce a "velvet finish," and again the nap or pile may be required to be laid down on the face of the fabric, producing in this manner what is termed a "face finish" to the fabric. In the latter two instances, the interlacing of warp and filling is not discernible, neither the individual threads, both being in this instance hid or covered by the pile or nap on the cloth.

With reference to treating worsteds, cotton worsteds, or union fabrics for a clear face finish, singeing, as used so extensively in connection with silk and cotton fabrics, is made use of in its stead.

Shearing should be practiced with the greatest of care especially in connection with woolen face finished fabrics, such as beavers, kerseys, broadcloths, etc., and which have to be most skillfully treated in order to get the evenness of pile required by these classes of fabrics, which necessarily requires a considerable amount of experience on the part of the operator to produce the required result.

Although shearing is generally one of the final operations in the finishing of most fabrics, yet in connection with some woolen, face finish, fabrics, the goods are sheared (cropped) at an intermediate stage of the finishing process, in order to thus be able to produce a fuller nap on the goods.

The operation of the shear requires a most careful manipulation, for instance, any inattention on the part of the operator is liable to result in cutting the cloth, due to folds, or wrinkles forming in the cloth as it passes to the shear cylinder of the machine; or again he may shear too low in some instances, thus influencing the wearing qualities of the fabric, in others the finish required, or again both.

There are two general styles of shears used in connection with finishing woolens and worsteds, known respectively as "single" and "double" shear, indicating in the first instance a machine with one shearing mechanism, and in the second instance, two shearing mechanisms in the same machine for operating in unison on the same piece of cloth.

A double shear is thus simply two single shears set tandem on the same frame, the two sets of blades being stationed at different heights on the machine,

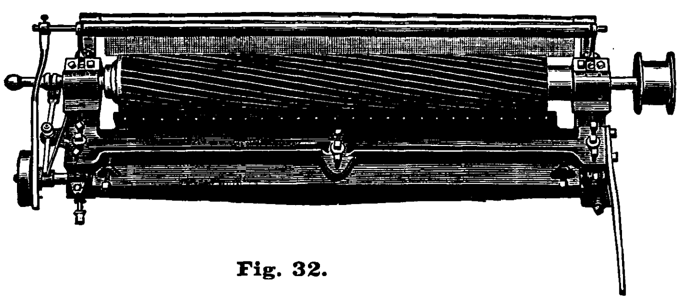


Fig. 32.

thus allowing the operator to watch both cutting lines at the same time.

The parts comprising the shearing mechanism in a shear are best explained by means of illustrations Figs. 32, 33, 34, and of which,

Fig. 33.

Fig. 32 shows in perspective view, a complete set of shear blades, the same comprising the shear cylinder and its boxes, the ledger blade and back, the

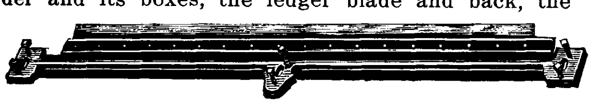


Fig. 34.

frame which holds the back for ledger blade, and boxes for the shear cylinder, the oil swab, and the vibrate attachment for the shear cylinder, all ready to set onto the machine.

Fig. 33 shows the shear cylinder, and

Fig. 34 the ledger blade and its back, in detail.

These three illustrations refer to the narrow

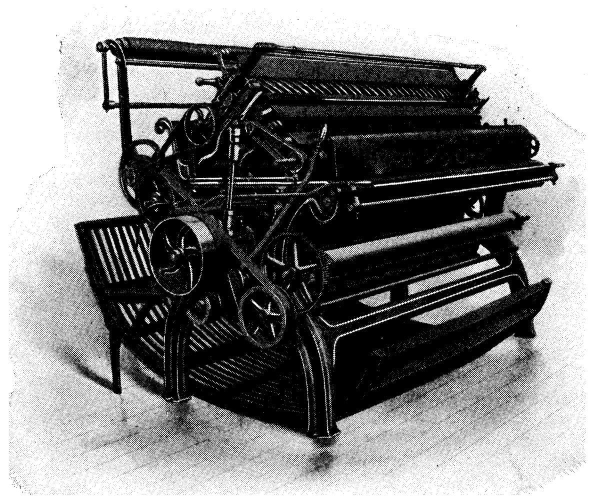


Fig. 35.

woolen or worsted shear as built by the Curtis & Marble Machine Co.; however blades for broad shears are similar, only that more adjusting screws are used.

The modern single and double shear, as built by the Parks & Woolson Machine Co., with all its latest improvements is shown by means of Figs. 35 to 41, and of which

Fig. 35 is a perspective view of a single shear.

Fig. 36 is a perspective view of a double shear, and

Fig. 37 is a sectional view of this double shear, also showing the passage of the cloth through the machine.

Figs. 38, 39, 40 and 41 are illustrations in detail of various shearing mechanisms used, viz.:

Fig. 38 shows in outline section the position of the shear cylinder and ledger blade in connection with a "plain steel rest;"

Fig. 39 shows in outline section the position of the shear cylinder and ledger blade in connection with a "steel rest," having a "list saving device" applied thereto;

Fig. 40 shows in outline section the position of the shear cylinder and ledger blade in connection with a "rubber rest," having a "list saving device" applied thereto;

Fig. 41 shows in outline section the application of a "felt cushion" to the "steel rest."

Referring now to Fig. 37, the cloth to be sheared, as shown by dotted line, is passed from the scray 1, up over a guide rod 2, then down around another guide rod 3 to a front draft roll 4, which with another guide rod 5 acts to put tension on the cloth as it is passed to the shearing mechanisms. From the rod 5, the cloth passes upwardly and over a guide rod 6, then around a specially shaped brush rest 7, which puts the cloth in position to have the nap on the face raised to a perpendicular position on the cloth by means of a raising brush 8 and in this condition the cloth travels to the cloth rest 9 of the