Feb. 14, 1933. R. A. MANEGOLD 1,897,731

METHOD OF DETECTING METAL PARTICLES IN SHEET MATERIAL

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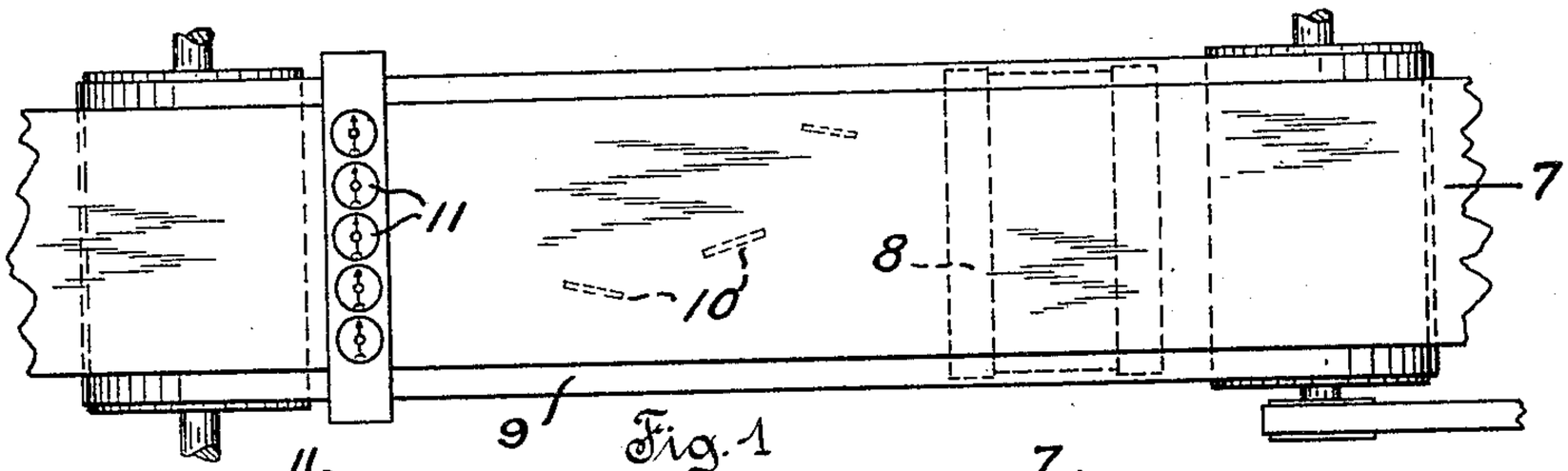

Fig. 1

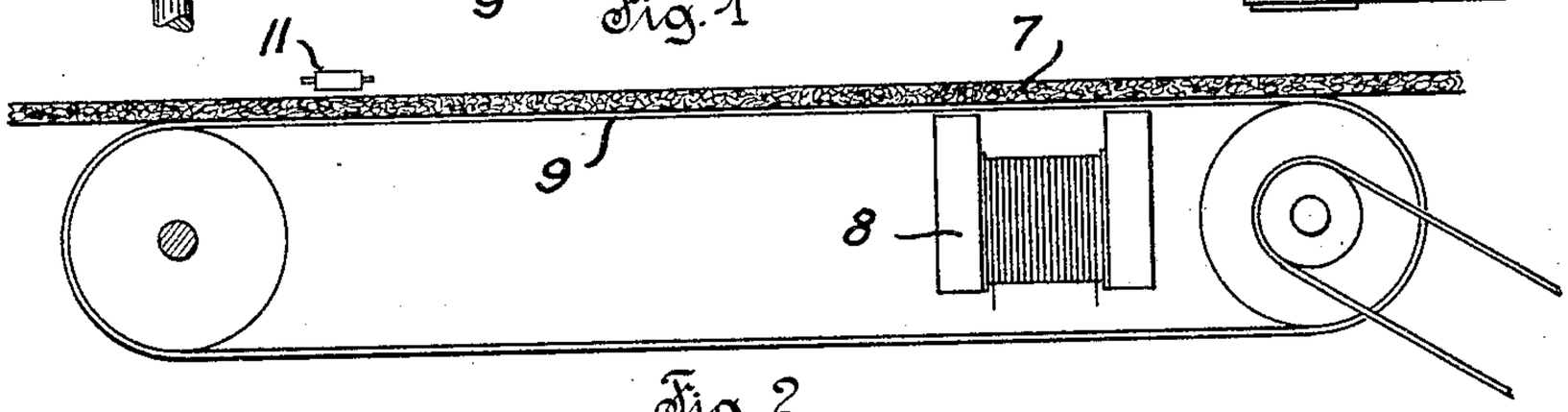

Fig. 2

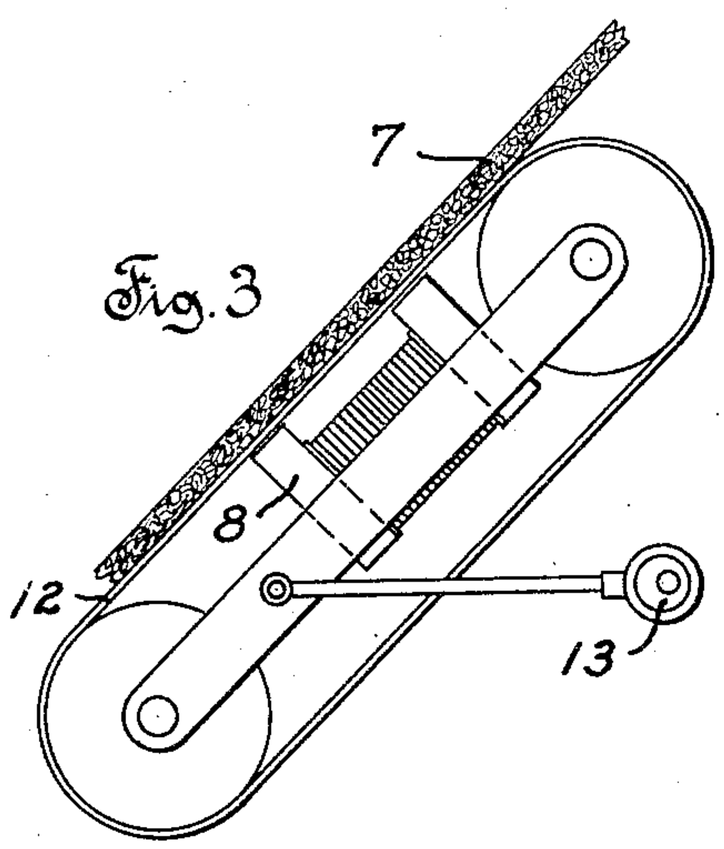

Fig. 3

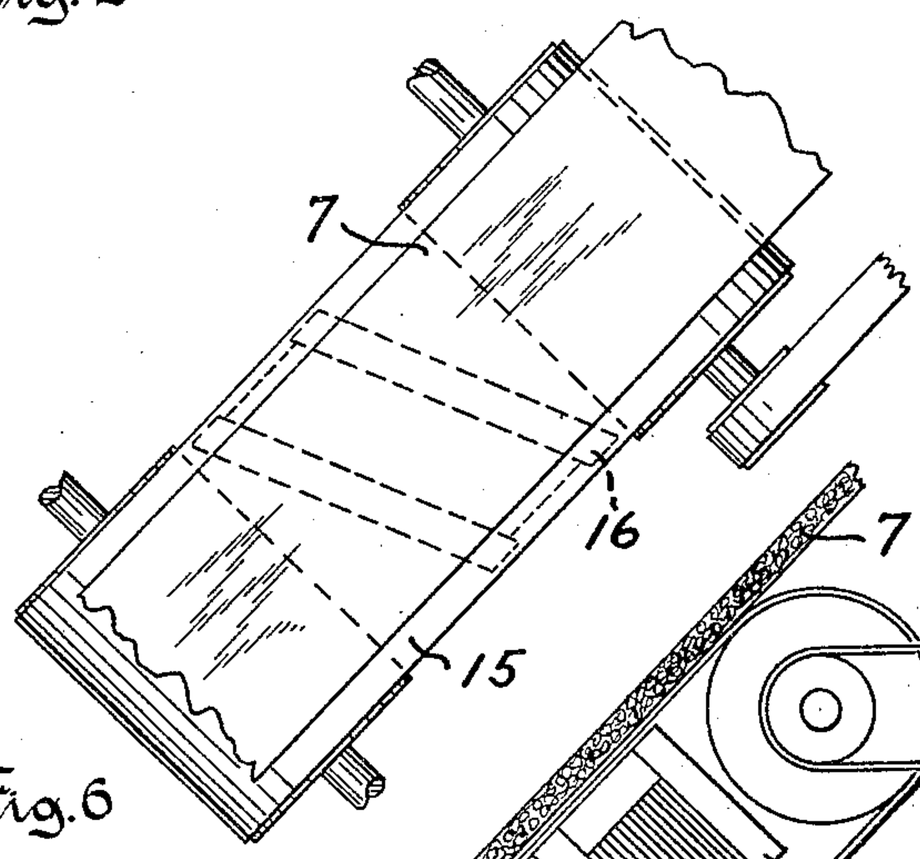

Fig. 6

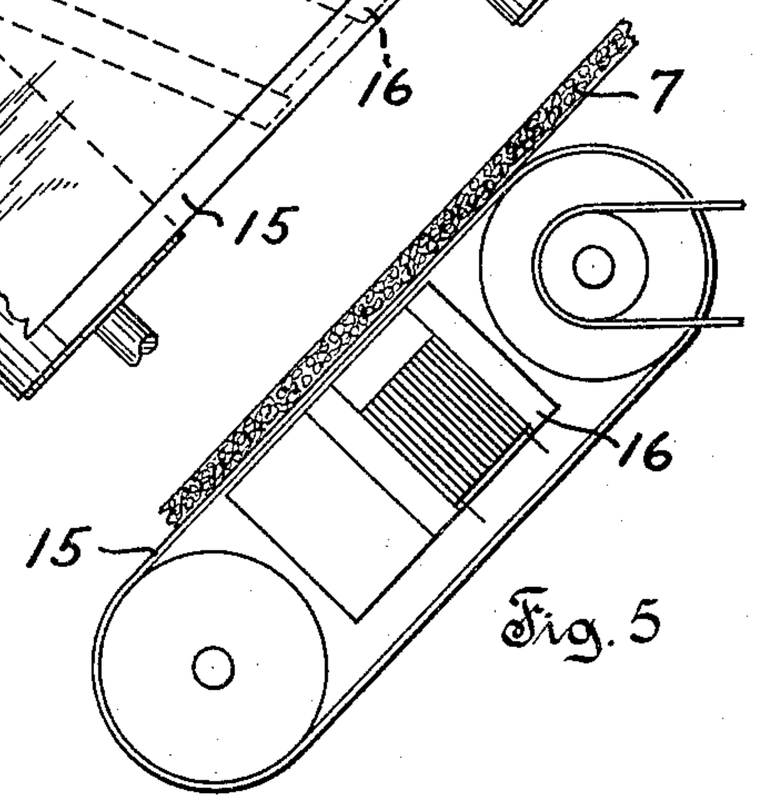

Fig. 5

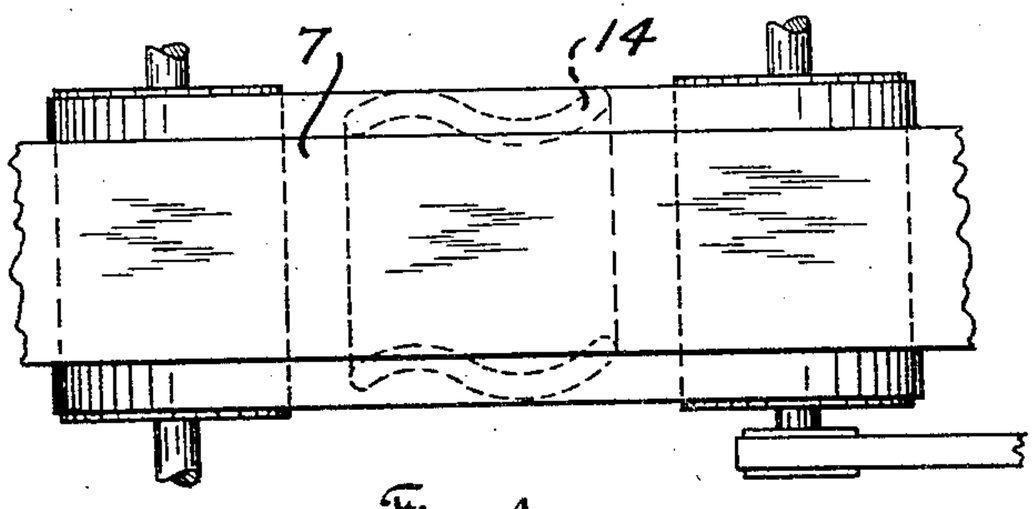

Fig. 4

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UNITED STATES PATENT OFFICE

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METHOD OF DETECTING METAL PARTICLES IN SHEET MATERIAL

Application filed February 17, 1928. Serial No. 255,203.

The present invention relates in general to an improved process of detecting and thereby facilitating removal of pieces of metal from sheets of material in which the pieces may have been embedded, and relates more specifically to an improved method of locating objectionable metallic particles while they are concealed in permanent sheets of a substance such as paper, felt or the like, in order to enable subsequent removal of the detected particles.

A general object of the invention is to provide an improved method of detecting and of facilitating removal of metallic particles from permanent sheets of material in which the particles may be either partially or completely embedded, by taking advantage of differences in the characteristics of the substances to determine the location of the particles.

It is common practice in the commercial production of hair felt and the like, to interweave or intertwine the hair with a fabric binder by means of mechanically reciprocated steel needles which push and pull the hair through the meshes of the fabric and thus produce the sheet. During the felt manufacturing process, the needles frequently break and relatively small pieces or particles of the metal, such as the point portions of the needles, become embedded or concealed in the felt sheets. The hidden metal particles are snugly confined within the felt by the hair wrapped about them, and are a source of considerable annoyance and extreme danger during the subsequent severance of the felt into smaller sheets, pads, wads, etc., and when handling or utilizing articles manufactured from the felt. It is therefore exceedingly desirable to remove the metal pieces or particles from the felt, immediately after the sheets have been produced. While a number of methods of detecting the location of such objectionable metal particles in sheet material, such as the use of X-ray machines, have heretofore been proposed, none of these prior methods have proven commercially satisfactory.

It is a more specific object of the present invention to provide a simple and reliable process of quickly and positively detecting pieces of magnetic material such as steel, concealed within sheets of fibrous substance such as hair felt, in order to facilitate subsequent removal of the metal. The improved process is capable of being carried on continuously with the aid of relatively standard equipment, and insures detection of all metallic particles having magnetic qualities, which may be associated with the sheets treated in accordance with the improvement.

A clear conception of the various steps of the improved process, and of the construction and operation of several assemblages of apparatus for exploiting the same, may be had from the accompanying drawing and the following detailed description. While four distinct embodiments of the invention have been specifically described and shown in Figs. 1 to 6 inclusive of the drawing by way of illustration, it will be understood that other practical embodiments within the contemplation of the present improvement, may occur to individuals skilled in the art.

In accordance with one specific embodiment of the invention illustrated diagrammatically in Figs. 1 and 2 of the drawing, the sheets of fibrous material 7 such as hair felt, are advanced either constantly or intermittently but at a relatively slow rate of speed, in close proximity to an electro-magnet 8 or a powerful permanent magnet. This transportation may be effected with an ordinary belt conveyor 9 and any metallic particles 10 such as steel needle points which may be embedded in the felt, are magnetized while passing through the field of the magnet 8, in a well known manner. The sheet of material 7 after passing through the energizing magnetic field, may be subsequently transported in close proximity to a series of compasses or similar detectors 11 which are preferably disposed beyond the range of action of the energizing field, and the magnetic needles of which normally point across or laterally of the path of travel of the sheets. When the concealed and magnetized metallic particles 10 pass near the magnetic needles, the particles im-

mediately function to deflect the adjacent needles away from their normal north-south position, and cause the compass needles to point toward the advancing particles. An attendant upon observing the direction of deflection of the compass needles may readily locate and subsequently remove the hidden metallic particles from the sheet. In order to insure detection of all of the embedded metal pieces, all portions of the felt should be advanced through the energizing magnetic field, and a sufficient number of compass needles must be employed so that hidden particles in all portions of the sheets will influence at least one or more of the magnetic detector needles. The energizing magnets 8 may be disposed directly beneath the felt conveying belt, and the compass needles may be located in staggered rows directly above the sheets some distance beyond the magnets. It will be apparent from the foregoing description, that the energizing magnets and the detector needles provide simple and reliable means for quickly and positively detecting or locating the successively advancing metallic particles 10 concealed within the felt, thereby facilitating subsequent removal thereof if such removal is desired.

In accordance with another specific embodiment of the invention illustrated diagrammatically in Fig. 3 of the drawing, the sheets of fibrous material 7 may be placed or deposited upon the upper end of an inclined surface 12 having an angle slightly less than the angle of repose. The supporting surface 12 may then be vibrated by means of a vibrator 13 so as to cause the fibrous sheet to slowly gravitate toward the lower end of the incline. One or more relatively powerful magnets 8 located adjacent to the incline and having magnetic fields through which all portions of the advancing sheets must pass, will interrupt the downward travel of the sheets when an embedded particle of metal enters the range of action of the magnets. The sheets will thus be held against further movement until the hidden metal particle has been removed or the sheet otherwise released. In this manner the presence of metal particles and the location thereof may be readily determined with the aid of a single magnetic device.

In accordance with still another specific embodiment of the invention illustrated diagrammatically in Fig. 4 of the drawing, the sheets of fibrous material 7 may be slowly advanced in a normally straight path, along a definite course. One or more relatively powerful magnets 14 having wave shape pole pieces may be positioned adjacent to the path of travel of the sheets, in such manner that the tractive effort of the magnets acting upon hidden metal particles embedded in the advancing sheets, will cause the sheets to be momentarily withdrawn from their normal path of travel thereby giving a visible indication of the existence of a hidden metal particle in the offset portion of the sheet. An attendant observing the offset motion of the sheet may then readily locate the metal particle or particles, and may remove the same if desired. In this manner, the presence of metallic particles and the location thereof, may likewise be determined with the aid of a single magnetic device.

In accordance with still a further embodiment of the invention illustrated diagrammatically in Figs. 5 and 6 of the drawing, the sheets of fibrous material 7 may be slowly advanced by gravity or otherwise, along an inclined plane 15 in a normally straight downward direction. One or more relatively powerful magnets 16 having pole pieces set on the bias relative to the direction of normal travel of the sheets, may be positioned adjacent to the path of advancement so that the tractive effort of the magnets acting upon hidden metal particles embedded within the moving sheets, will cause said sheets to be deflected from their normal straight path of travel and to move diagonally or at an angle thereto. An attendant upon observing the diagonal movement of the sheet, may then conveniently locate the metal particle and may if desired, remove the same. This apparatus may also be utilized to segregate the sheets containing metal particles from those which are free from metal, the diagonal motion being utilized to deposit the sheets with metal therein in receptacles located laterally of the receptacles which receive the other sheets. In this manner, the presence of metal particles may also be determined with the aid of a single magnetic device.

From the foregoing description of several forms of apparatus for exploiting the improved process, it will be apparent that the present invention provides a simple and extremely effective method of detecting the presence of metallic substances 10 in permanent sheets of non-metallic or non-magnetic material 7. The removal of the detected particles may not be necessary in all cases, as it may be possible to utilize sheet material containing embedded metal particles for certain purposes, and the present detecting method will then be employed only to segregate the sheets containing metal particles 10 from those which are free from such particles. In all cases, the presence of metallic particles is effectively determined by virtue of the magnetic characteristics of these particles, and the non-magnetic characteristics of the sheets, with the aid of one or more magnets. While the use of compass or other types of detector needles acting upon the previously magnetized

particles, will perhaps provide a more positive and sensitive means of detecting the presence of metal particles, the mere use of magnets without auxiliary detectors will probably suffice in cases where the existence of minute metal particles within the sheets is not seriously objectionable.

While the invention has been specifically described as being especially applicable for the purpose of detecting the presence of steel needle points or the like in hair felt, it will be apparent that the process is capable of more general application. The improvement is especially applicable in the treatment of permanent sheets wherein the embedding and confinement of the metal particles is such that the particles cannot be withdrawn from the sheets by the tractive effort of a magnet alone. It will be apparent that the principles involved are readily applicable to the treatment of other than hair felts and to the treatment of certain kinds of paper and composition board, as well as to the treatment of fabric and rubber sheets.

It should be understood that it is not desired to limit the invention to the exact sequence of the process steps or to the details of construction of the apparatus specifically described herein, for various modifications within the scope of the claims may occur to presons skilled in the art.

It is claimed and desired to secure by Letters Patent:—

1. The method of ridding sheets of nonmagnetic material of embedded metal particles, which comprises, subjecting all portions of each sheet of the material to the direct influence of a powerful magnetic field to permanently magnetize embedded magnetizable metal particles, utilizing the magnetization of said particles to definitely determine the location thereof both laterally and longitudinally of the sheet, and subsequently removing the detected particles.

2. The method of ridding sheets of nonmagnetic felt of embedded metal particles, which comprises, advancing all portions of each sheet through a powerful magnetic field to permanently magnetize the embedded magnetizable metal particles, subsequently advancing the sheet in proximity to a compass needle to cause the needle to definitely locate the magnetized particles both laterally and longitudinally of the sheet, and finally removing the detected particles.

In testimony whereof, the signature of the inevntor is affixed hereto.

ROBERT A. MANEGOLD.