On the application of suitable mechamism to a case of amputation of both hands / by F. Gustav Ernst.

ON THE

APPLICATION OF SUITABLE MECHANISM

TO A CASE OF

AMPUTATION OF BOTH HANDS.

BY

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THIS PAMPHLET

IS

RESPECTFULLY DEDICATED

TO

SIR JOSEPH LISTER, BART.,

M.B., F.R.S., F.R.C.S., LL.D.,

AS A

GRATEFUL TOKEN OF ADMIRATION AND ESTEEM,

BY

THE AUTHOR.

INTRODUCTION.

THE cases of amputation of both hands are comparatively rare, and have hitherto received very little thought as to the provision of suitable mechanism to take the place of the lost members. Occurring as they generally do in Hospital patients, there has not been that scope for experiment and trial which alone enables the successful application of any adscititious aid. I do not think, therefore, any excuse needed for the publication of the following case, which was placed in my hands by Sir Joseph Lister about twelve months ago. My previous experience was confined to two cases: one, a Hospital patient, in which the question of "What can you do for ten pounds?" immediately limited the scope of invention. The other, a gentlemen who was born without even rudimentary arms, and where the artificial upper extremities served only for appearance. It was, therefore, with some hesitation, that I undertook to consider what might be done to replace the functions of the lost hands (I do not think that anyone can fully realize the intense helplessness of any person in such a plight until they go carefully, step by step, into the ordinary every-day requirements of individuals), and my progressive acquaintance with the sad needs of the patient stimulated my efforts to the utmost. My principal thought, or, rather, my first inspiration, was to render the dependent patient independent, and I con-

sidered that if the appliances and their attachment could be rendered applicable by the patient himself, one of the great difficulties of the adaptation of mechanism would be solved. It would be wearisome to enter into a description of the many experiments and failures made during the fitting and perfecting of the several instruments, which latter I shall shortly describe. I may, however, mention that it has only been after twelve months patient perseverance and careful thought that I have been able to accomplish that which I have illustrated. No little praise is, however, due to the patient, whose admirable and courageous perseverance has conduced in a very great measure to the end attained, and without which my efforts would have been greatly marred. As the case is, I believe, unique, it would be interesting to give a brief outline of the history of the accident, as illustrating the endurance of human beings, and the heroism of Surgeons when not surrounded with every necessary surgical aid.

HISTORY OF THE ACCIDENT.

Mr. C—— C——, *æt.* 28, whilst shooting alone in Central Africa, during the May of 1891, had discharged one barrel of a double-barrelled gun and then stood "at ease" with his hands crossed on the muzzle of the undischarged barrel, the butt resting on the ground; owing to some cause yet unexplained, but believed to be due to the dogs who accompanied Mr. C—— C——, the other barrel was exploded. The patient remembers nothing but hearing a dull thud, and he was then

thrown senseless to the ground. After remaining a short time in this condition, he regained consciousness, and then fully realized that both his hands had been blown to pieces. This occurred at 11 a.m.; pulling himself together as best he could, he made his way to the encampment, about a mile off, where his friends were awaiting his arrival, this journey having to be walked under the burning rays of the "interior" African sun. About half-way, he encountered three Mashonas, who refused to lend any assistance unless they were immediately well paid; under the circumstances, this was impossible, and the rest of the journey had to be continued unaided. On Mr. C—— C——'s arrival at the encampment, the serious nature of the accident was apparent to all, but fortunately Mr. C—— C——'s brother was able, from previous experience of accidents, to render most valuable first aid, the hands being bandaged up until a surgeon could be procured. The nearest medical man was posted at Fort Salisbury, a distance of 30 miles, and to enable Mr. C—— C—— to travel over this space, his friends went in search of a conveyance. After some time, the only thing they could procure was a bullock-wagon (a native cart made of wood, with the axle fixed, and the wheels revolving thereon in an exceedingly loose manner), and in this the patient was carried the entire distance. The absence of roads caused considerable delay in transit, and it was not until 4·30 a.m. the following morning that Mr. C—— C—— reached the Hospital at Fort Salisbury, the journey having occupied from 7 o'clock the previous evening.

The condition of the sufferer can be easily pictured: faint, weary with pain, and tormented by the agonies of such a ride, it is almost impossible to believe that

human endurance could have borne so much, or that the patient could have survived. Nevertheless, the arrival at the Hospital gave him new hope. I think that it should here be placed on record how heroically the surgeon in charge acted; with only the assistance of the Hospital orderly and Mr. C—— C——'s brother (whose assiduity in nursing and care throughout was invaluable), Dr. R. F. Rand, F.R.C.S. Eng., M.D., M.B., C.M., made a most excellent amputation of both hands, removing the right just above the wrist-joint and the left at the middle-third of the fore-arm. The operation lasted three and a half hours, and I think there are very few cases on record where a surgeon has, single-handed, administered the anæsthetic and performed the operation at the same time. Unfortunately, during the after-treatment some suppuration supervened, resulting in inflammation of the shoulder-joint of the right arm, leaving this fixed. This, naturally, seriously handicapped the application and use of any mechanism, and by the advice of Dr. Rand, Mr. C—— C—— returned to England to seek the assistance of Sir Joseph Lister. Subsequently to a visit to this gentleman, the adhesions were broken down, and passive movements have almost entirely restored the joint to its normal condition.

DESCRIPTION OF THE APPARATUS.

Artificial hands with articulated fingers are practically useless, and although there have, at times, been produced some really clever mechanical contrivances to enable a hand to remove a hat from the head, or pick up objects, yet this achievement is exceedingly

limited, and the utility of the movement of no avail except for the particular purpose for which it has been designed. Hands are, therefore, chiefly useful as a matter of personal appearance, and bearing this in mind, I have contrived suitable apparatus with which definite purposes can be attained. I have before said that my inspiration was to render the "dependent independent," and I think I can fairly claim to be the first who has succeeded in constructing the arms in such a manner as to enable the patient to adjust them himself. My efforts, however, have not stopped here, for I have also arranged that the patient shall be able to dress himself, and perform many offices for which, hitherto, he has been dependent on others.

Fig. 1 Pl. 1 represents the amputated stumps. Pl. 2 illustrates the arms. As I have before said, I have borne in mind the necessity of making these appliances so that they shall be applicable without help, and with the exception of the strapping of the upper-arm sockets to the waistcoat, this has been carried out. Fig. 2 shows the left arm, and Fig. 3 the right arm. Both are constructed on the same principle, and a description of one will suffice for them both.

The fore-arm is fitted to a leather bucket A, which is attached to the upper-arm socket B by leather straps C C¹. I should mention that the leather bucket A is very carefully moulded to the lower part of the stump, so that the rotation movement of the fore-arm is fully maintained in using any of the appliances. To the upper-arm socket, two axial steels are attached, D D¹, the ends corresponding to the centre of the elbow-joint; by this means the lower bucket is constantly kept in position on the fore-arm in either the fully-extended or flexed position; it is very usual to attach

the lower bucket to the upper by side steels, but I think it will be readily seen that to do this would have entirely stopped the rotation movement, and the retention of this is of the utmost consequence. This I consider an important point. The next noticeable feature is the attachment of the upper-arm socket. How to do this was at first a difficult problem to solve, and after many experiences was arranged for in the following manner: the half of the upper-arm socket B was constructed of leather, strengthened by steel ribs; in the front a broad elastic band E was attached to the inner side, and edged with a stiff leather flap H, in this flap a series of holes were punched, and between these, closer to the edge, a series of smaller holes. The object of this was as follows: on the opposite side of the upper-arm socket to that on which the elastic was sewn, five metal studs were fastened, and I considered that if the leather could be stretched over these, that the elastic tension would be sufficient to keep the apparatus in place. The smaller holes were, therefore, used to lever the larger holes over the studs, and this was accomplished by a small crook, which was placed in the opposite stump and then reversed to the other stump when the other arm was to be finally attached.

On reference to Pl. 3, Fig. 4, the action of fastening the upper-arm sockets will be explained. Here also will be seen the method of attachment of the upper-arm sockets to the waistcoat. I should also mention that a large piece of elastic was inserted at the back of the waistcoat to admit of free movement of the arms. Fig. 5 represents an ordinary hook, shown in position at Fig. 4. Pl. 4 illustrates the mode by which the trousers are fastened, and also the waistcoat. The former garment is cut with a large flap in front, which

is held in the illustration by the clothes fastener, Fig 7, Pl. 4; this little crook is fitted with a steel collar to prevent the instrument passing too far through the slits. The body-band of the trousers is fitted with a wide leather belt, to one end of which a long stud is attached; part of the other end is free, and a series of holes punched, in order that any degree of tightness may be attained. A small hole is punched in the end of the strap, and with the crook the strap is pulled over the stud in the same manner as the upper-arm sockets are fastened. To return to the front flap: this is connected to large hooks, which are sewn on to the body-belt, and the illustration of the action shows how the crooks are used; the smaller to steady the hook, and the larger to attach the flap. In a similar way the waistcoat is also fastened, large studs take the place of buttons, and small holes at intervals serve to form a fulcrum for the crooks by which the one side is passed over the other.

Many will probably ask here, "but how are these crooks and other instruments fixed to the arm sockets without help?"—that is, by the patient himself. This was a somewhat difficult question to answer, but, nevertheless, I succeeded by the following arrangement. The usual methods of attaching any instrument to a socket are, first, by a screw, and, secondly, by the snap-spring arrangement, so generally familiar. Both of these were useless in this case, and I had to devise an entirely new plan. A round end is usual to all instruments, but this would be fatal to an easy adjustment, for it would be impossible to place the instrument accurately *in situ* so that any snap or pin could hold it in position. A square end and socket seemed to me the only solution of the difficulty, and

I will refer to the wood-cuts, Figs. 8, 8A and 8B, for a description of how this was carried out. A A represents the leather arm socket, to the end of which the

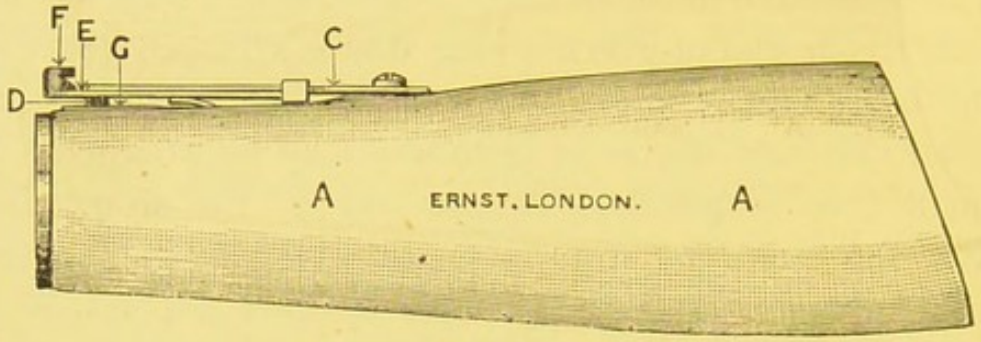

Fig. 8.

block B is fixed, and into which the wrist-plate is screwed. The plan of detachment can be understood on reference to the sectional drawings, 8A and 8B. The square hole for the insertion of all apparatus is indicated at K, L representing the end of an instrument

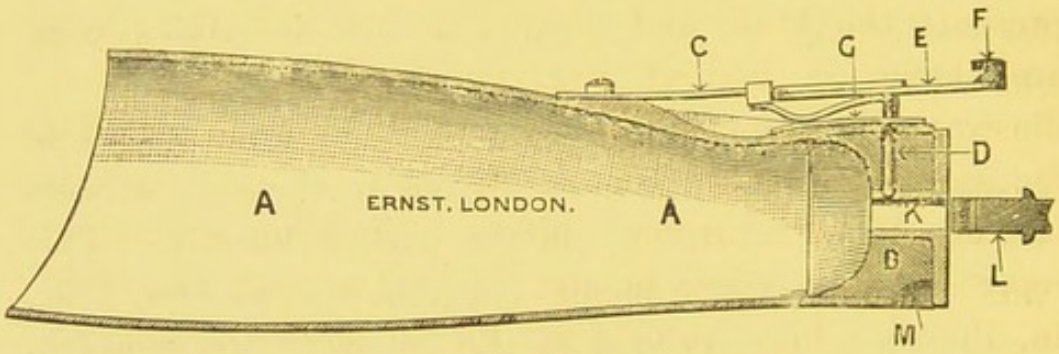

Fig. 8A.

about to be introduced. Before removing or placing an instrument the pin D must be raised; this is performed by pulling the notched end F forward, which is fixed to the end of the lever E, this lever being curved at its further end, and running on the runner G. The action of bringing this forward raises the spring C, to the end of which the pin D, already described, is attached. The curve of the lever E is just sufficient to raise the pin clear of the square socket and admit

any apparatus, which, after insertion, is fixed as in Fig. 8B. The small cavities M are made to enable the

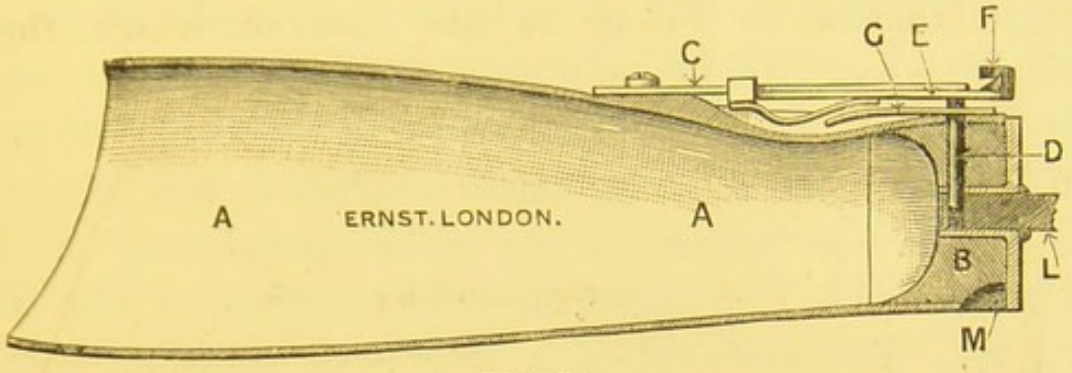

Fig. 8B

notched end F to be easily caught and drawn forward by the opposite arm, a very slight touch sufficing to close the spring when the necessary apparatus is inserted. Fig. 8 is an external view of the mechanism.

Pl. 5, Fig. 9, illustrates the arms and hands properly applied, and in Pl. 6, Fig. 10, we have the appearance of the patient when dressed. Pl. 7 represents the knife and fork, Figs. 11 and 12; these are shown in use at Fig. 13. On Pl. 8 I have illustrated an improved spoon with lip, Fig. 14, suitable for use with liquids; Fig. 15 the same in use. A new instrument for grasping objects or holding a glass is represented at Figs. 16 and 17, Pl. 9, and also Fig. 18, Pl. 10. Figs. 19 and 21, Pl. 11, show the adaptation of a shaving-brush, and Fig. 20, Pl. 11, illustrates a razor. The method of using a hair-brush is illustrated at Fig. 23, Pl. 12, and the mechanism of the hair-brush itself at Fig. 22. The stem terminates in a ball and socket movement, permitting the necessary alteration of the brush to the contour of the head. A tooth-brush and its mode of employment is indicated by Figs. 24 and 25, Pl. 13. Boot-hooks and their attachment to the sockets are also described by Figs. 26 and 27, Pl. 14. The most needful and useful art

of writing is provided for by the instrument shown at Fig. 28, Pl. 15, and illustrated in use at Fig. 29, Pl. 15. I am enabled at Pl. 16 to give a facsimile of some writing which Mr. C—— C—— has kindly sent to me, and allowed me to publish. During the fitting of the many instruments, I was asked whether it was possible to enable the patient to pay money personally. After some thought, I arranged the simple instrument Fig. 30, Pl. 17. This consists of a steel rod, split its entire length and spring-tempered, the purse from which the money was extracted being attached to the bag containing the instruments, illustrated later on. The purse was made to contain two rows of coins, large and small, half the portion being exposed after the flap was opened. It will be understood that the pressure of the clip on the edge of the coin was sufficient to open the clip, and enable the coin to be extracted as represented at Fig. 31, Pl. 17.

The most important invention with regard to this case, is that which I have termed the "lavatory arrangement." At no time does the utter helplessness of such a case strike one more forcibly than at the thought of the necessity of being obliged to depend upon an attendant at certain periods. The idea of devising an apparatus to dispense with this attendance was the earliest that occurred to me at the outset of the case. I made many inquiries as to what had been done in previous instances, but could find that nothing had been attempted in this direction. Pl. 18 illustrates the instrument I have designed for this purpose. Fig. 33 shows the apparatus prior to use; the end A is inserted in the socket of the left arm and firmly secured. Upon the vulcanite pad B the lavatory paper is placed, and one end each side turned under the base of the pad

by the plain crook which is attached to the right socket. The pad is then brought up to a right-angle position to the arm, as shewn at Fig. 32, and in this movement two important actions are accomplished. These are done in the following way: the stem is jointed at C, between this joint and the pad a spring clip E is hinged at D, this clip terminating in a forked end, F F, shown at Fig. 34 (it is these ends which secure the paper against the pad B). The end of the clip presses against the projecting arm H, which forces the forked ends into position. To maintain this angle, the main shaft K is fixed by a catch L. These two movements take place simultaneously, and it will be quite understood that to release the paper after use, it is only necessary to press the lever L, when the lever re-assumes the position of Fig. 33 and the paper is disengaged. Pl. 19, Fig. 35, shows the instrument attached to the arm. Fig. 36, Pl. 20, represents a driving or riding hook. Fig. 37 illustrates a simple device for opening a door; the stem A terminates in a double rack and pinion movement B acting on the arms C C, the ends of which are lined with india-rubber. By rotating the stem either to the right or left, the arms are made to open or shut, and the strength of the grip on any handle is sufficient to turn it. Fig. 38 gives a general idea of the special bag I designed for the containing and easy transmission of the several appliances.

F. GUSTAV ERNST.

80 Charlotte Street,

Fitzroy Square, W.,

London, *March*, 1893.

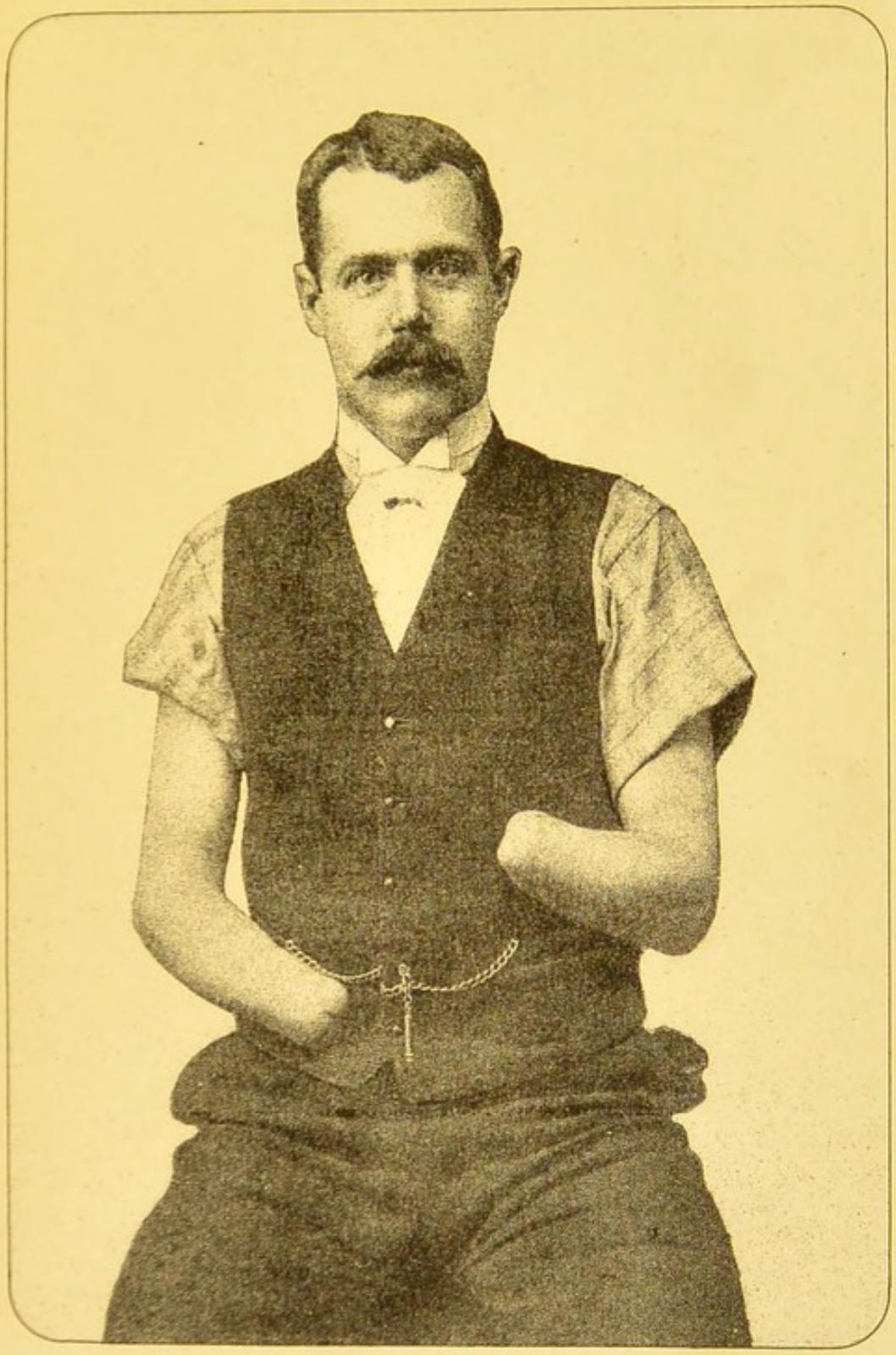

Fig. 1.

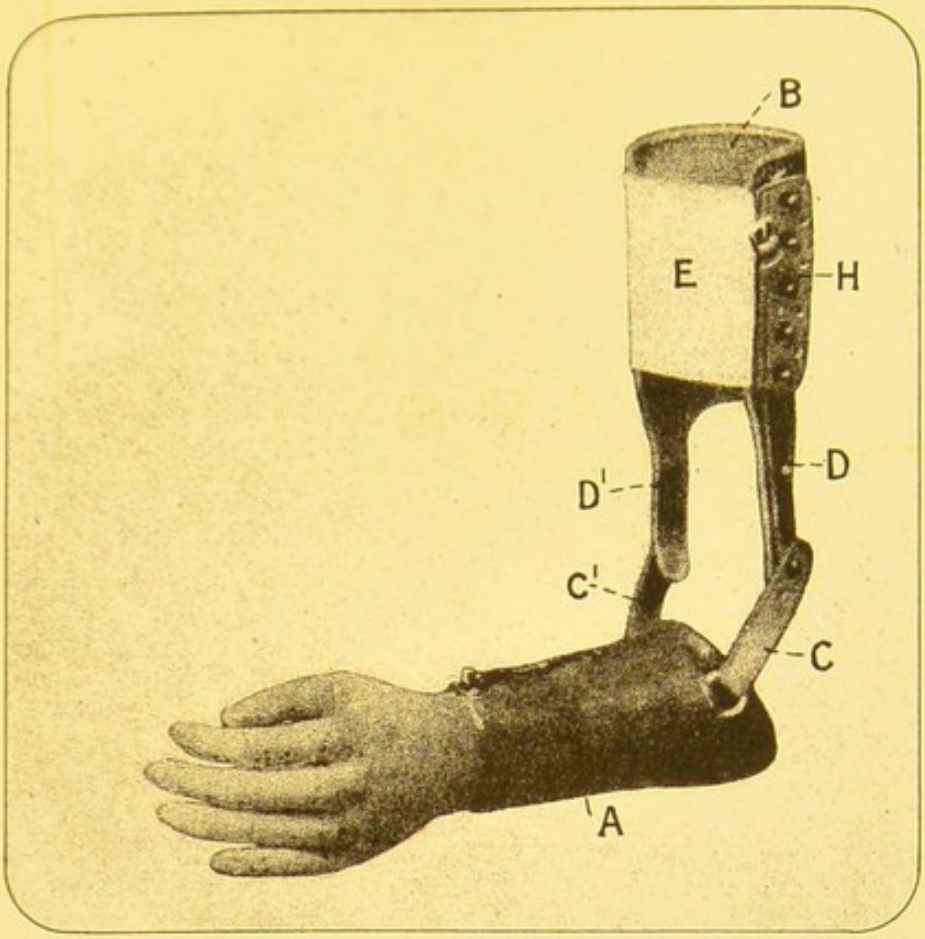

Fig. 2.

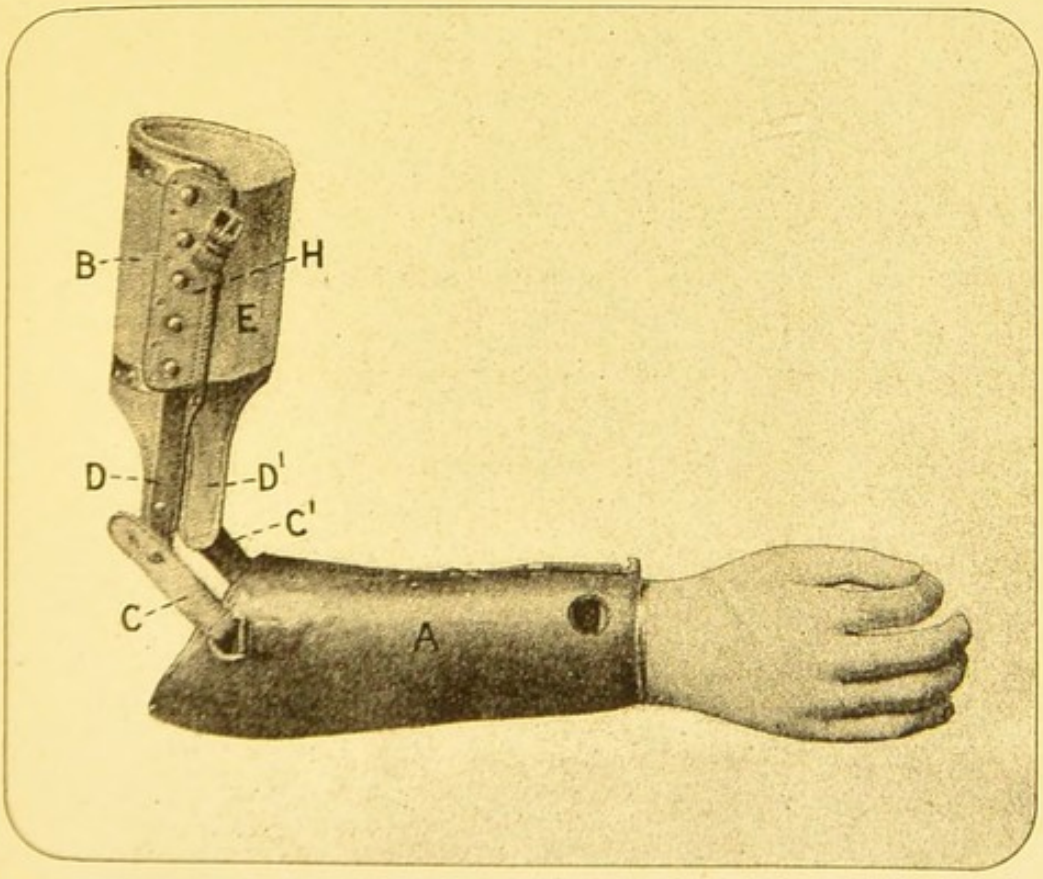

Fig. 3.

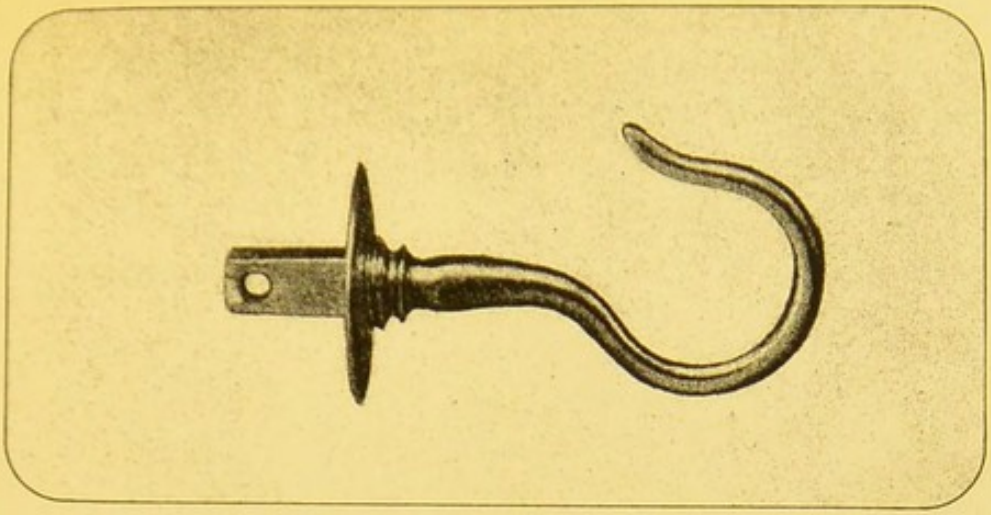

Fig 5.

Fig. 4.

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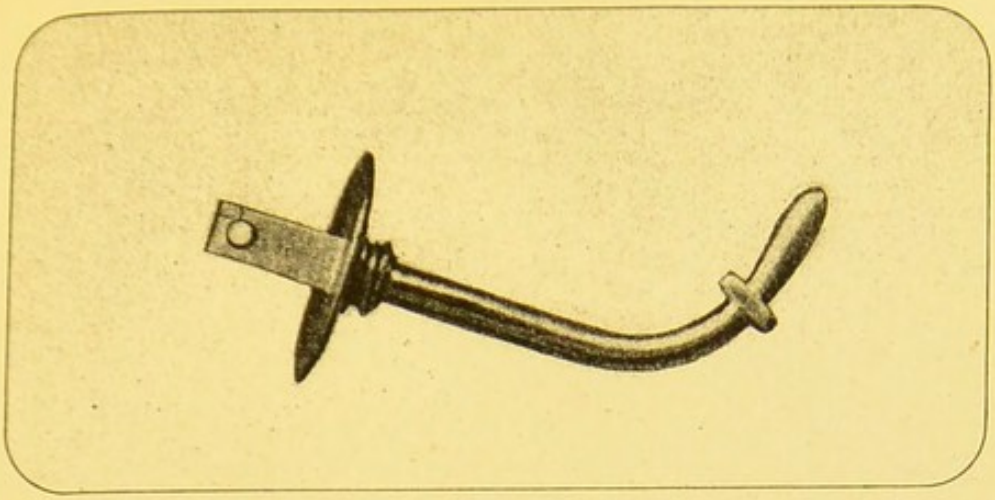

Fig. 7.

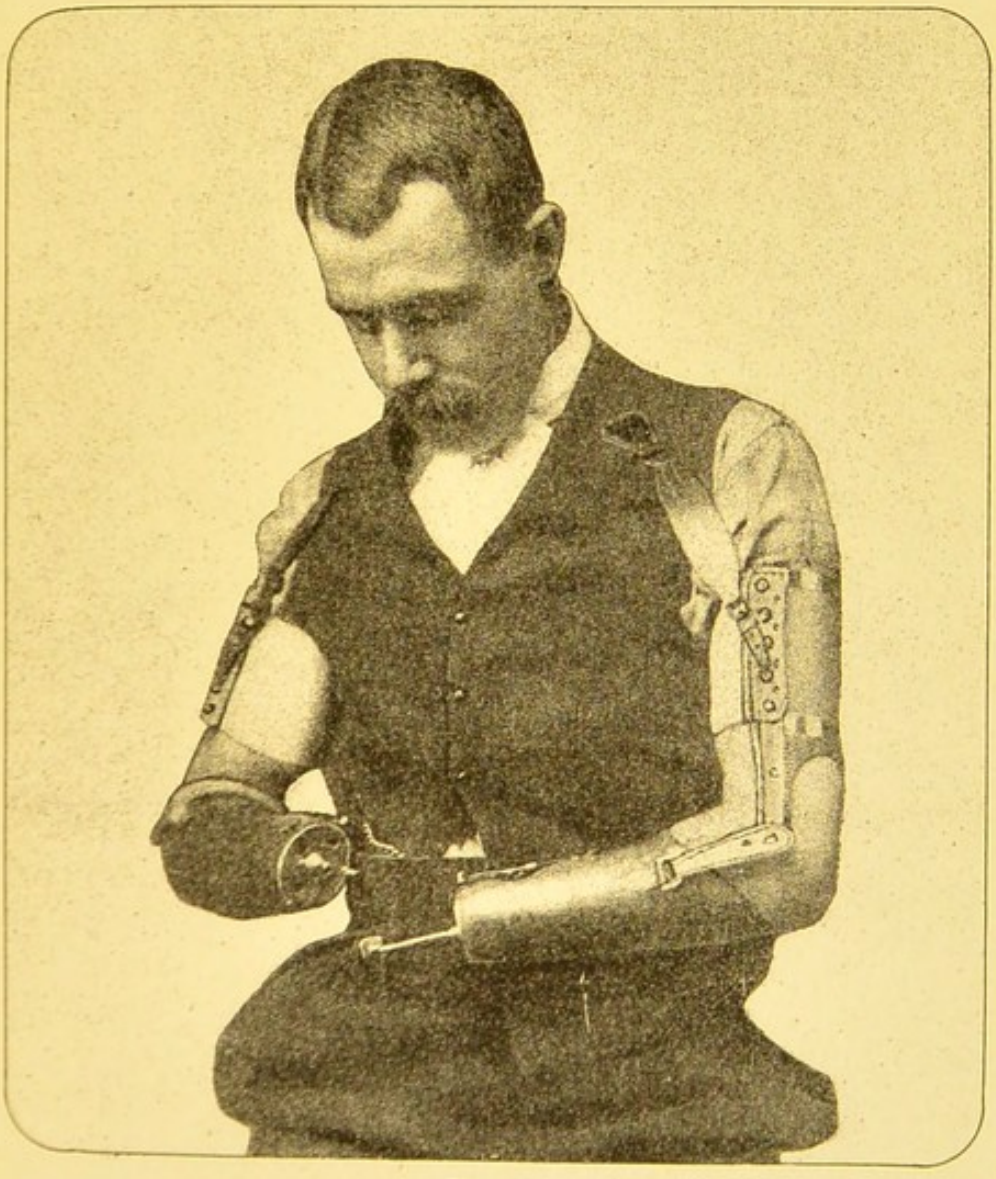

Fig. 6.

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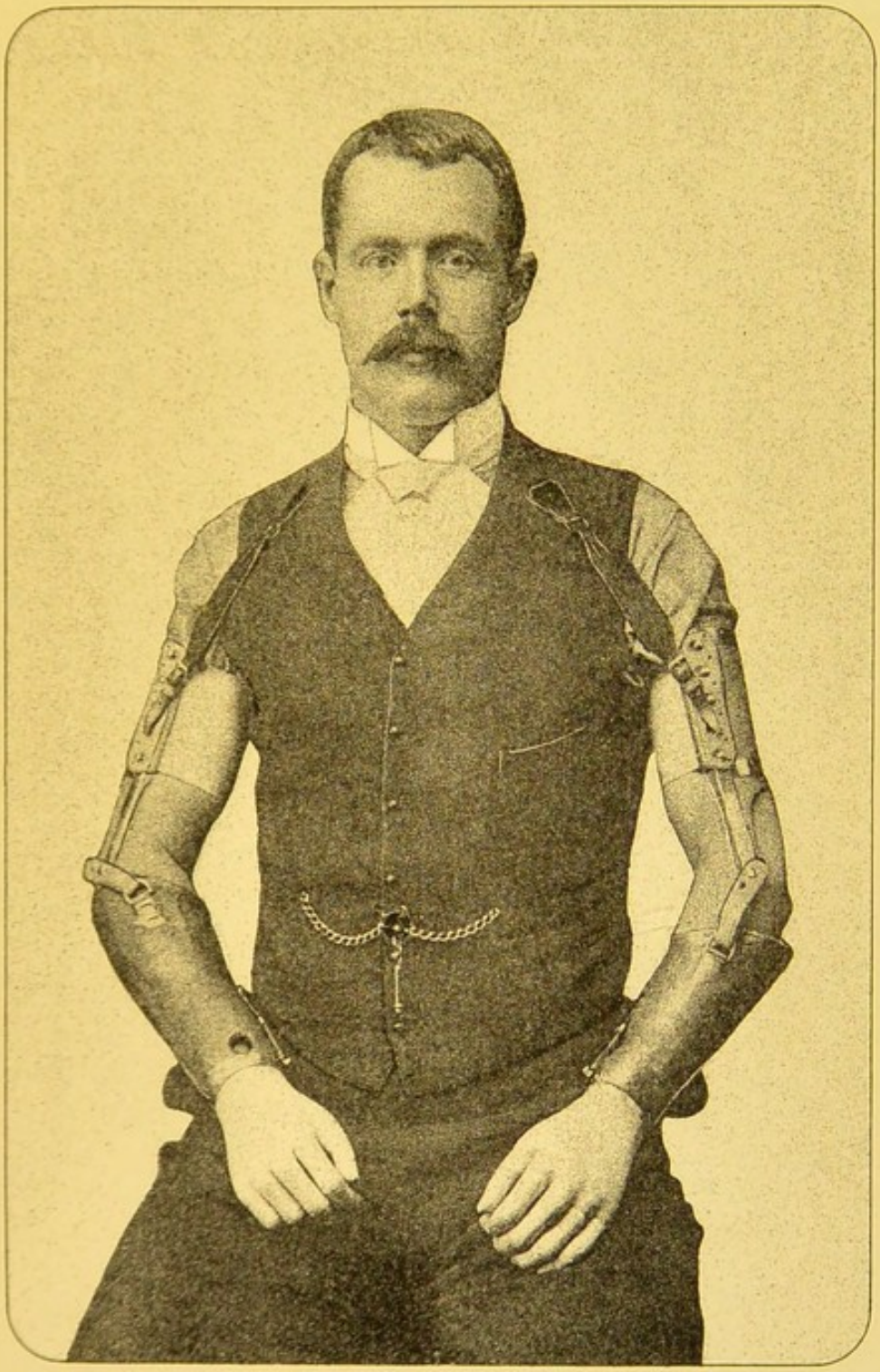

Fig. 9.

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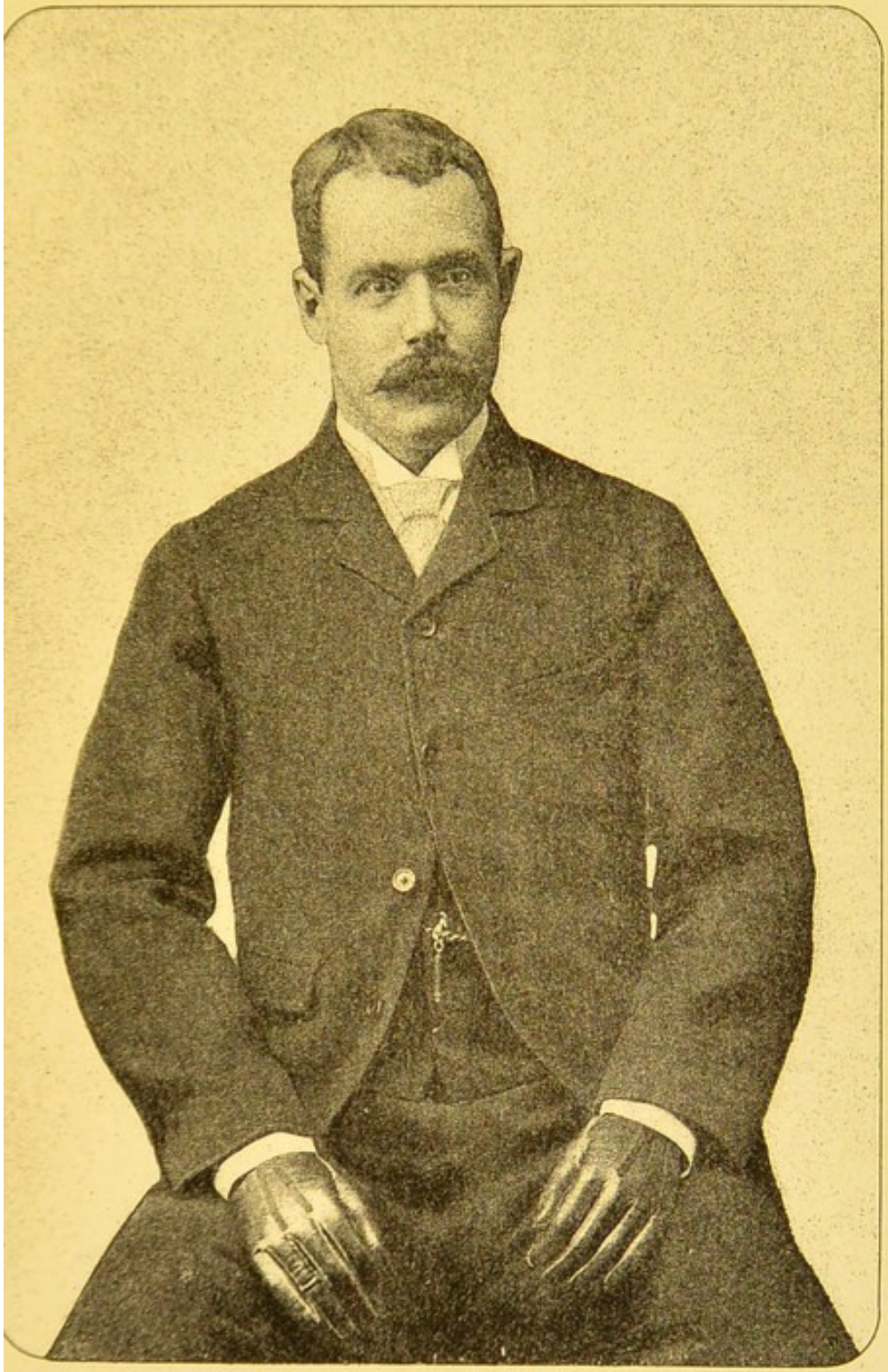

Fig. 10.

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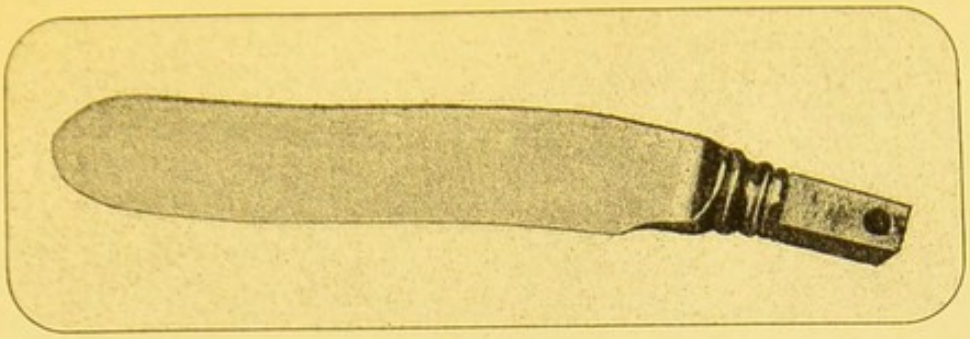

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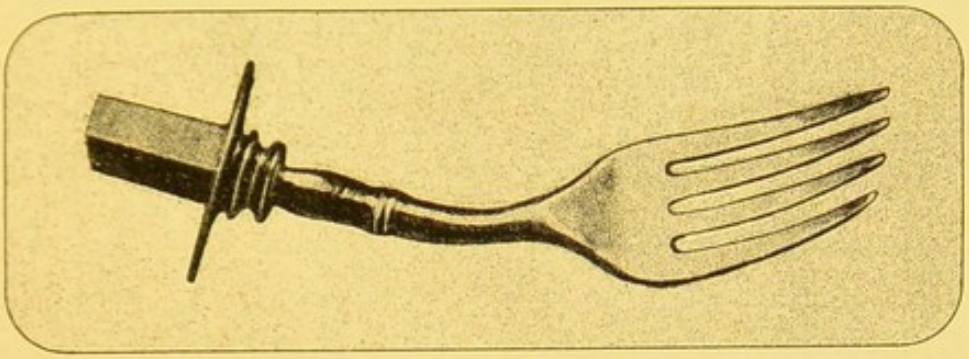

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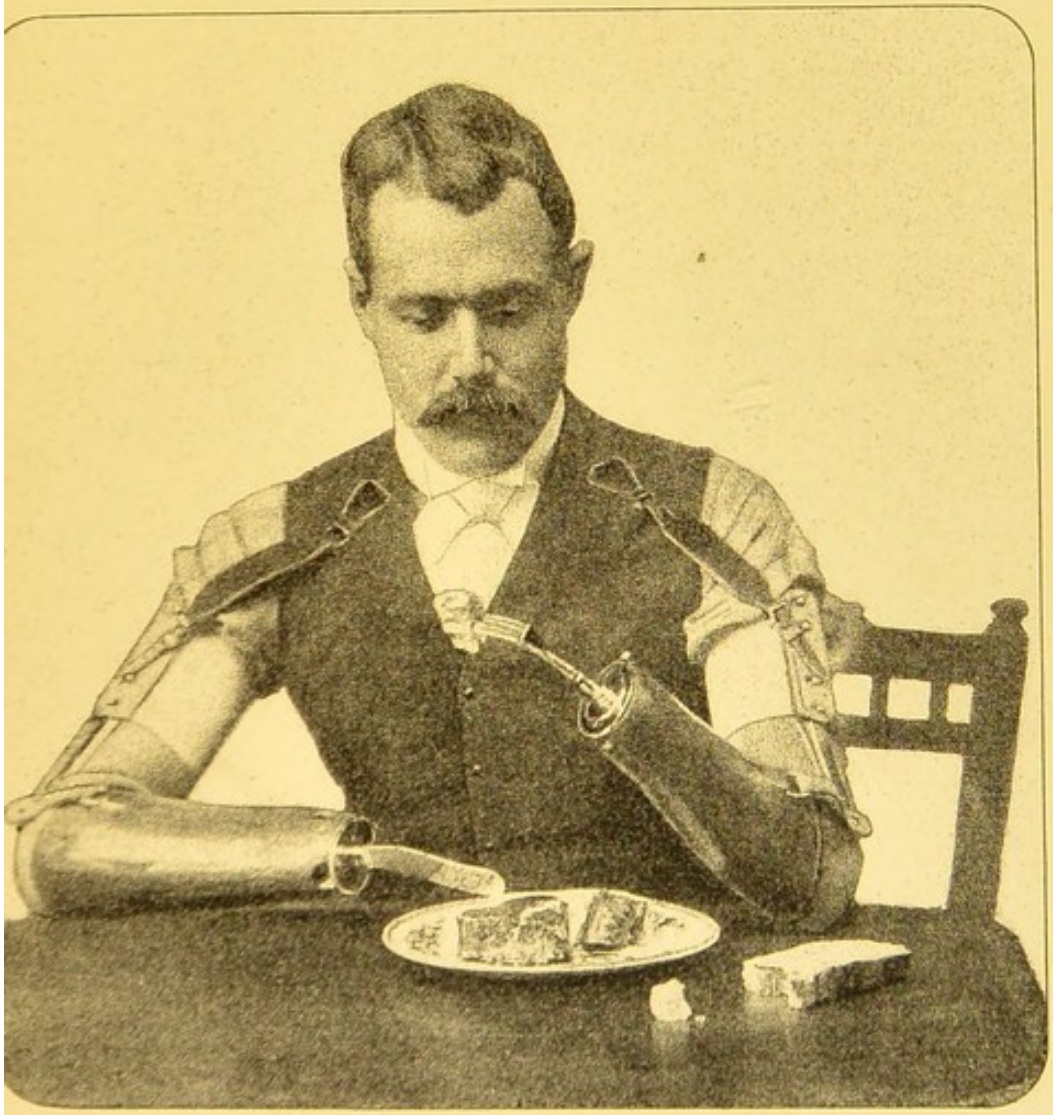

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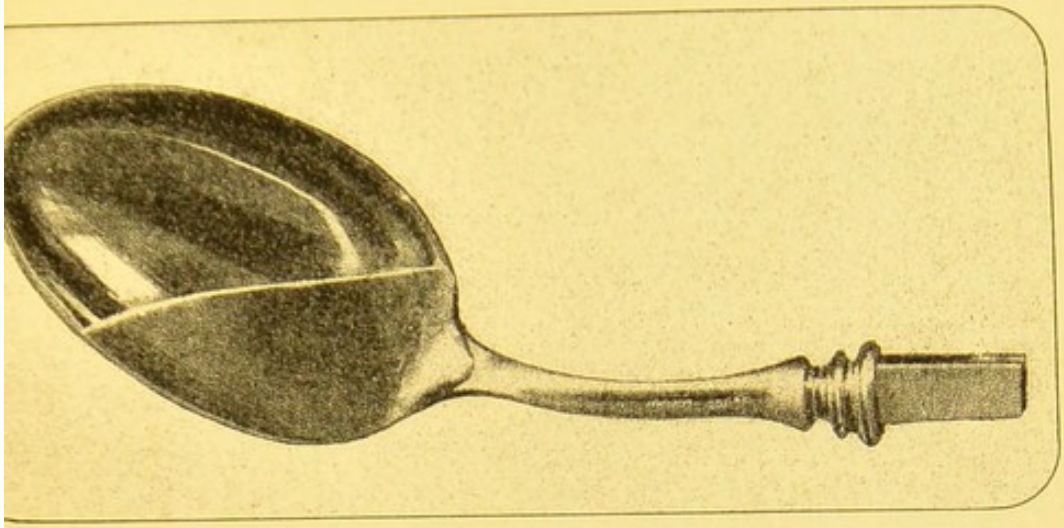

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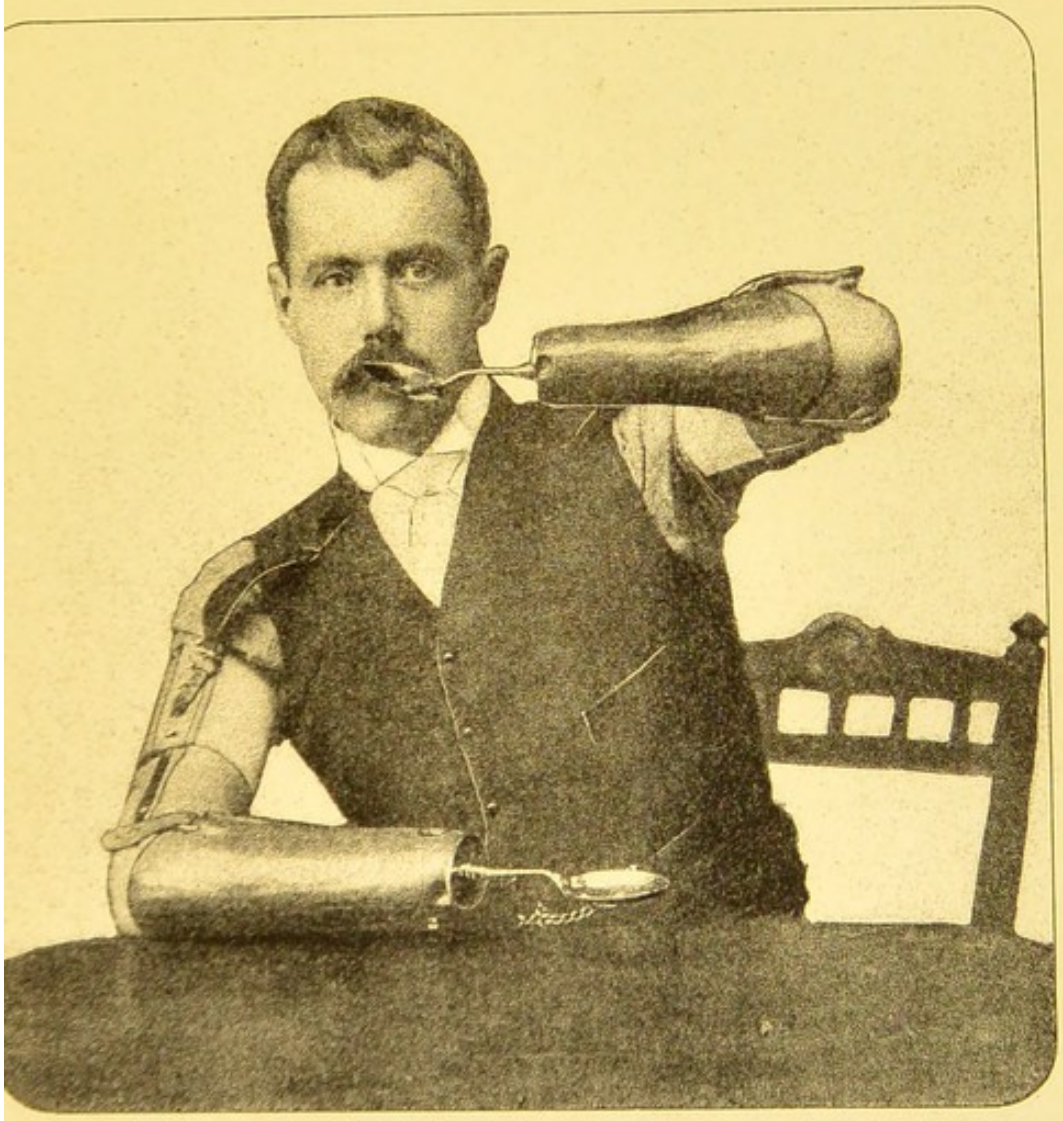

Fig. 15.

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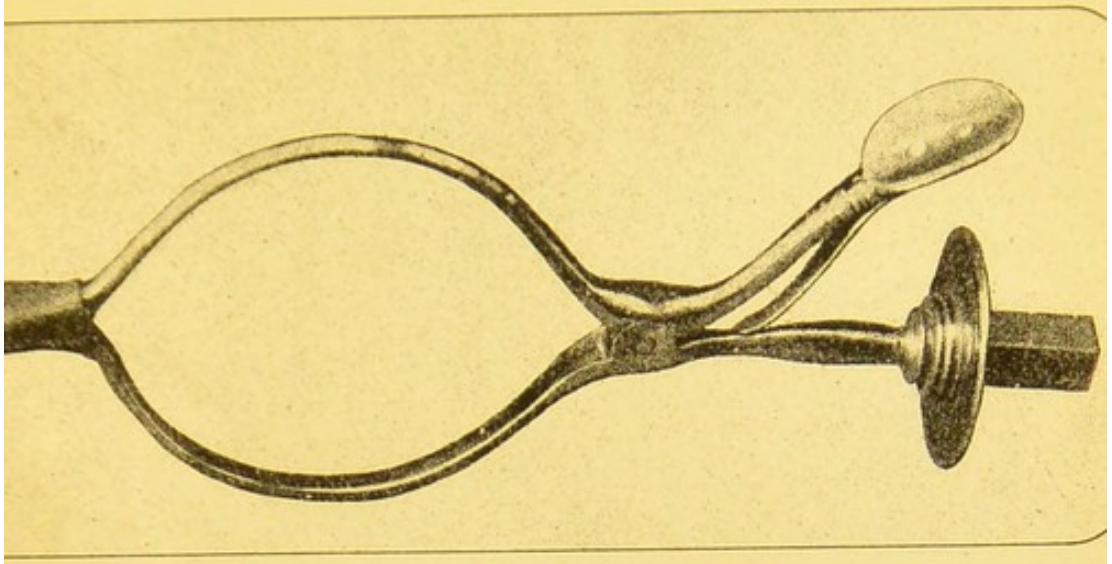

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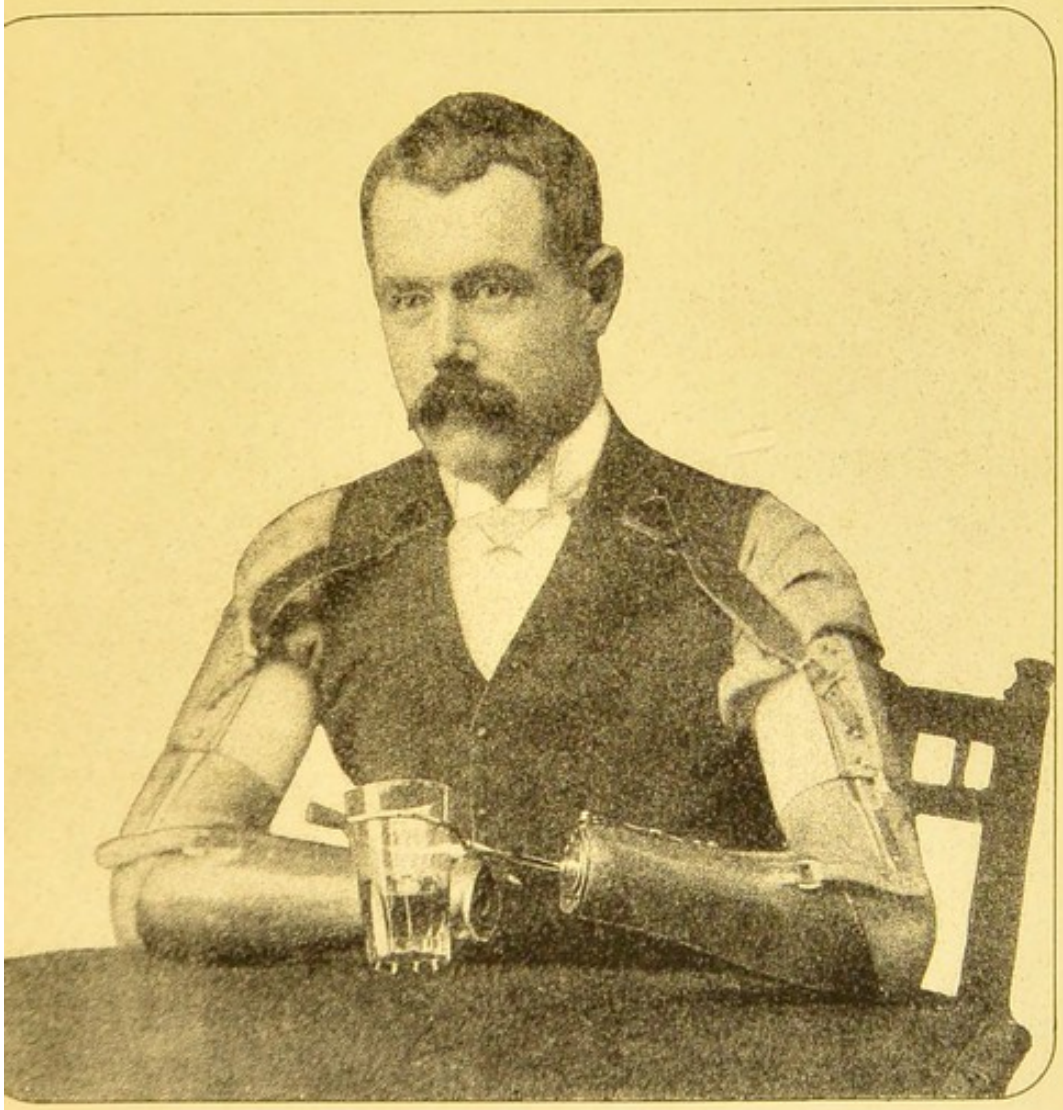

Fig 17.

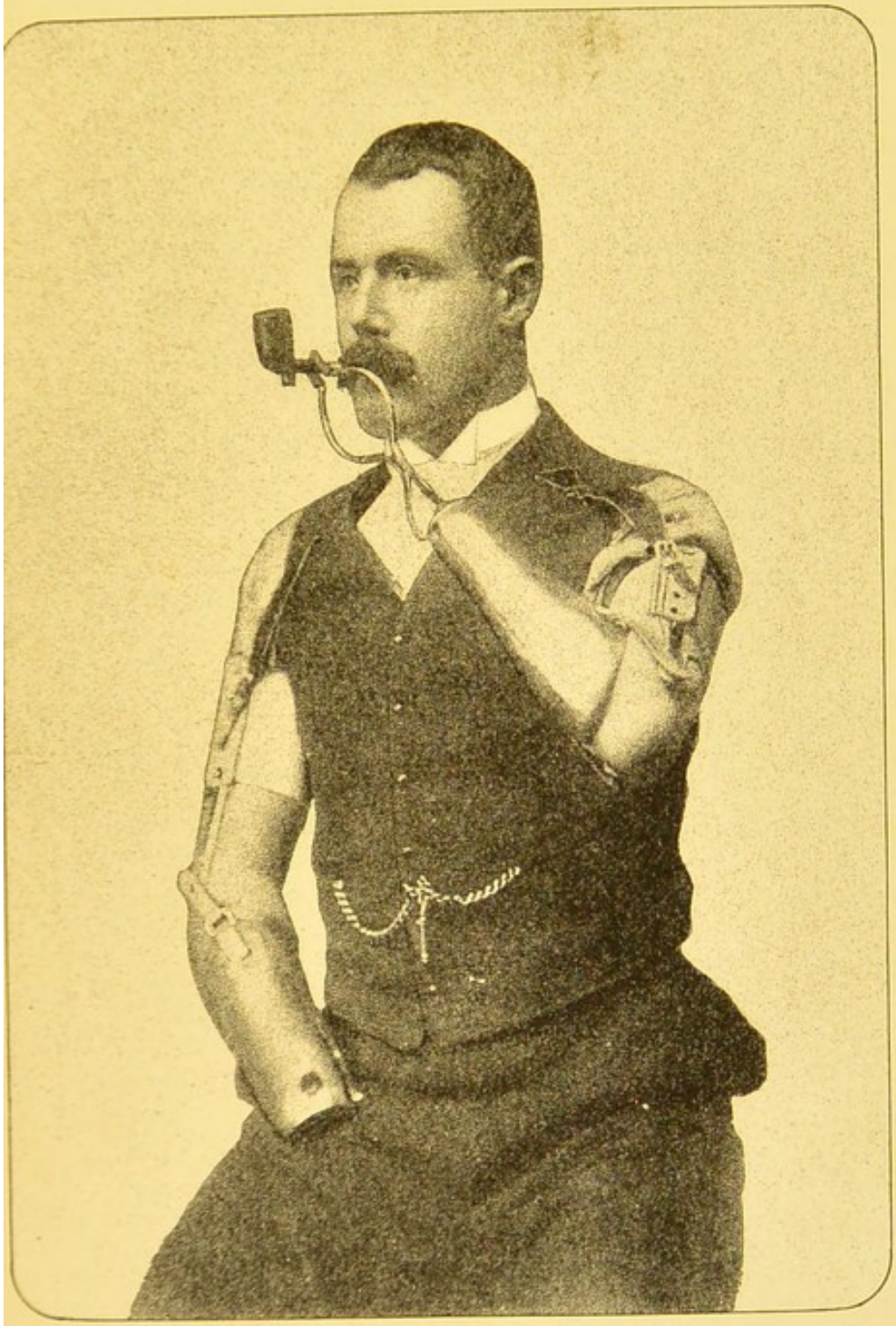

Fig. 18.

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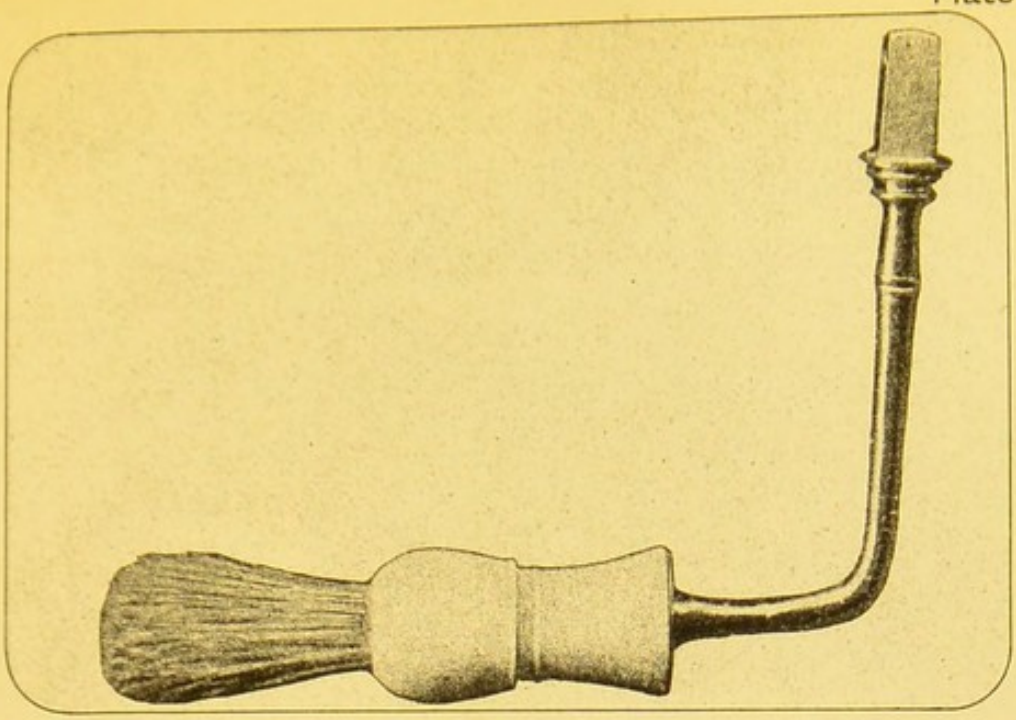

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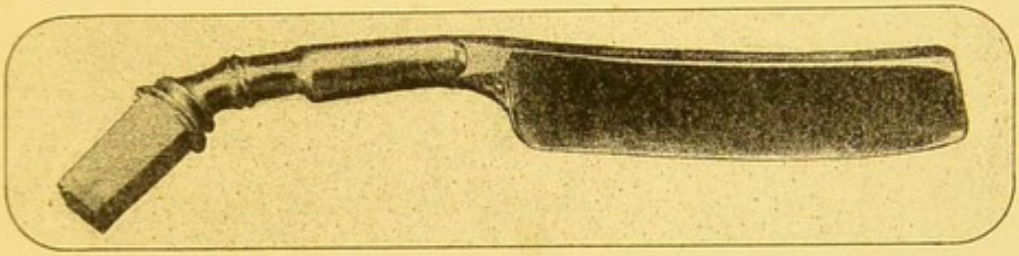
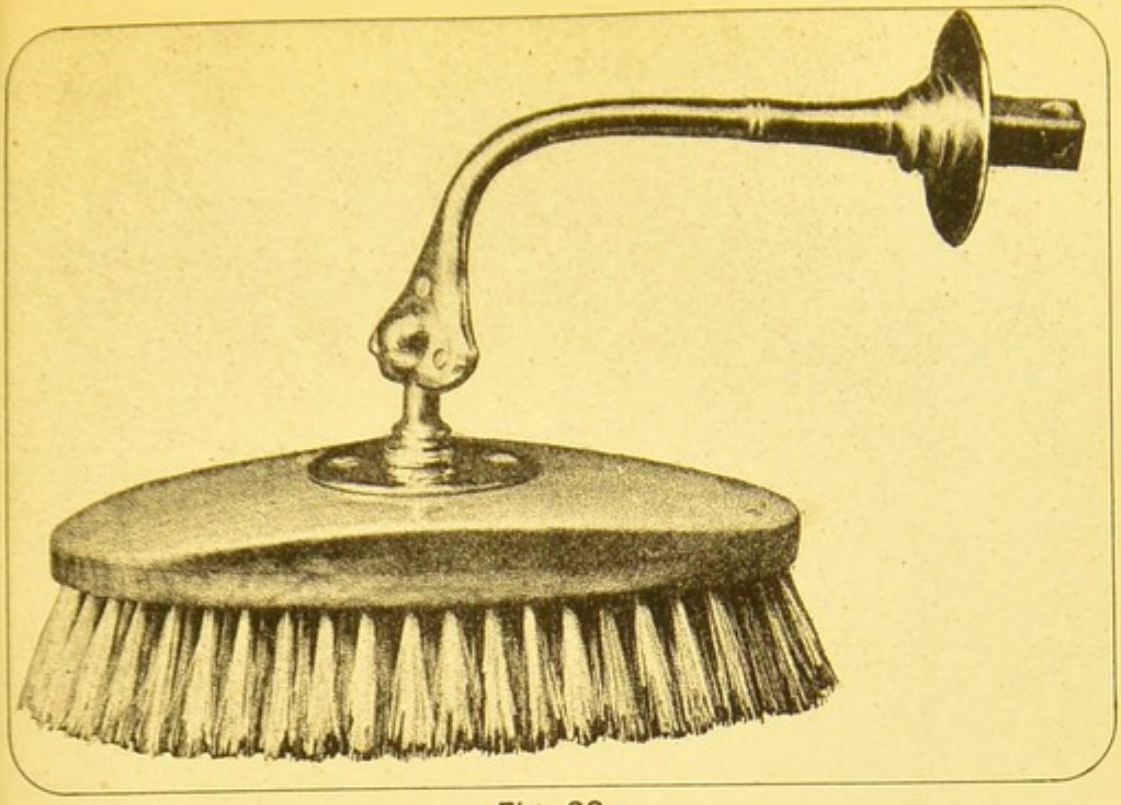


Fig. 20.

Fig. 21.



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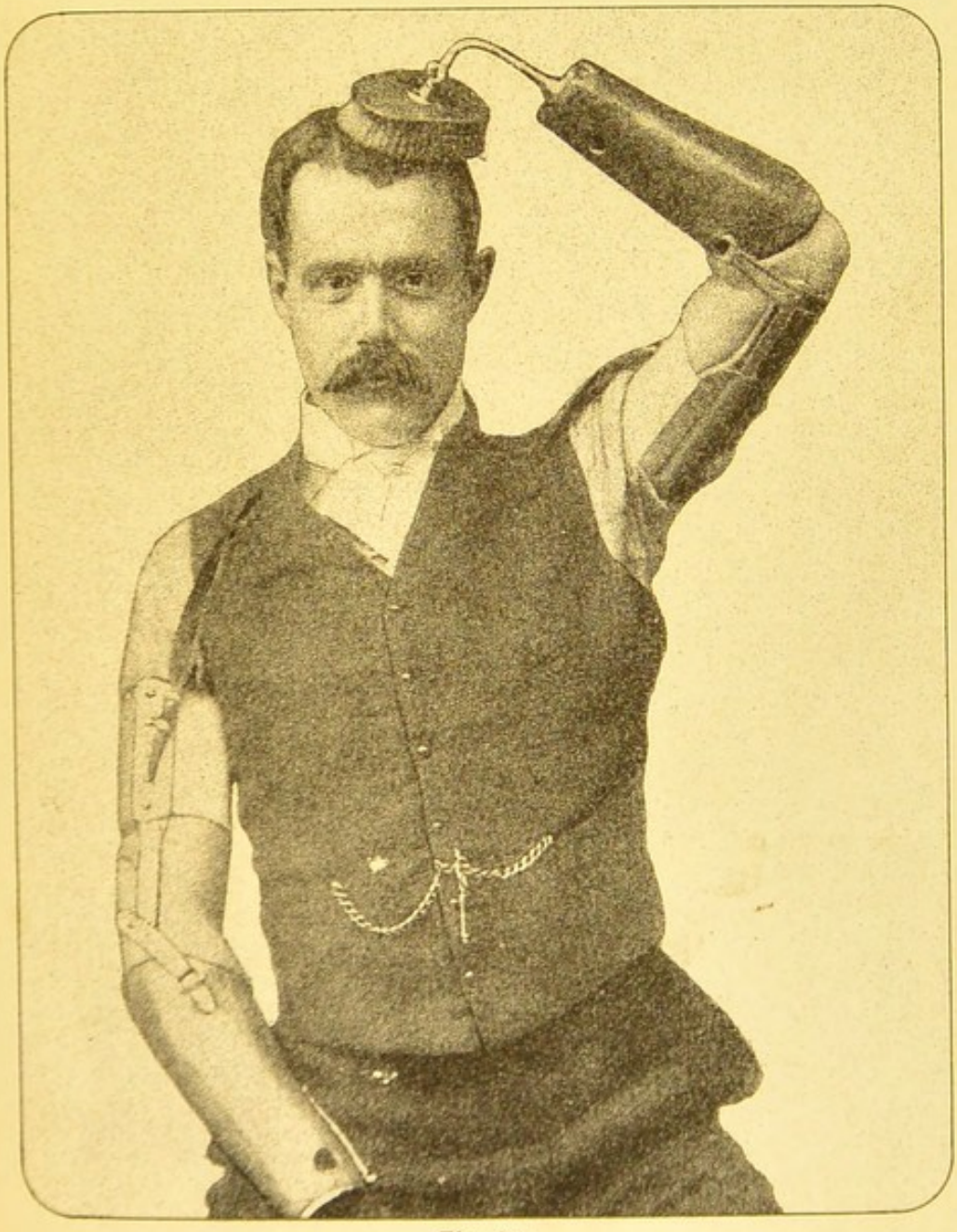

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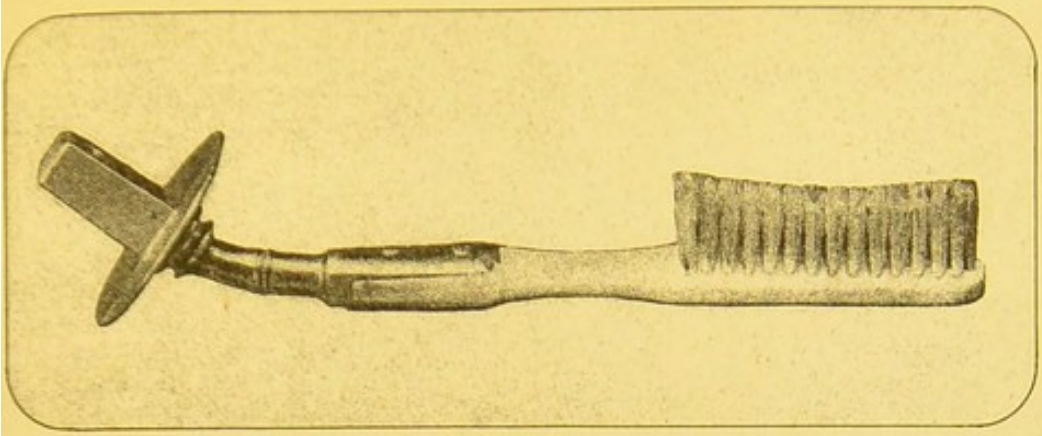

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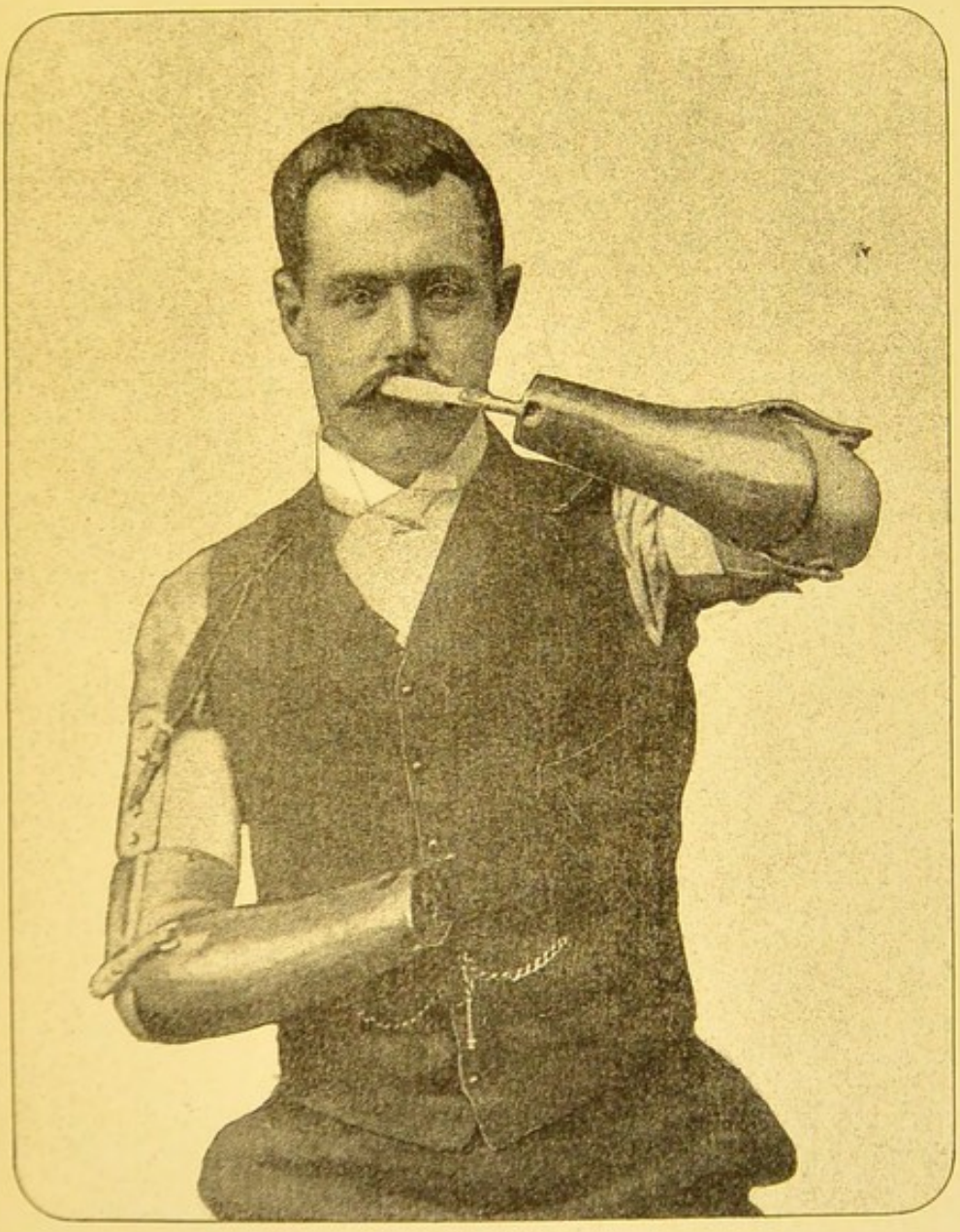

Fig. 25.

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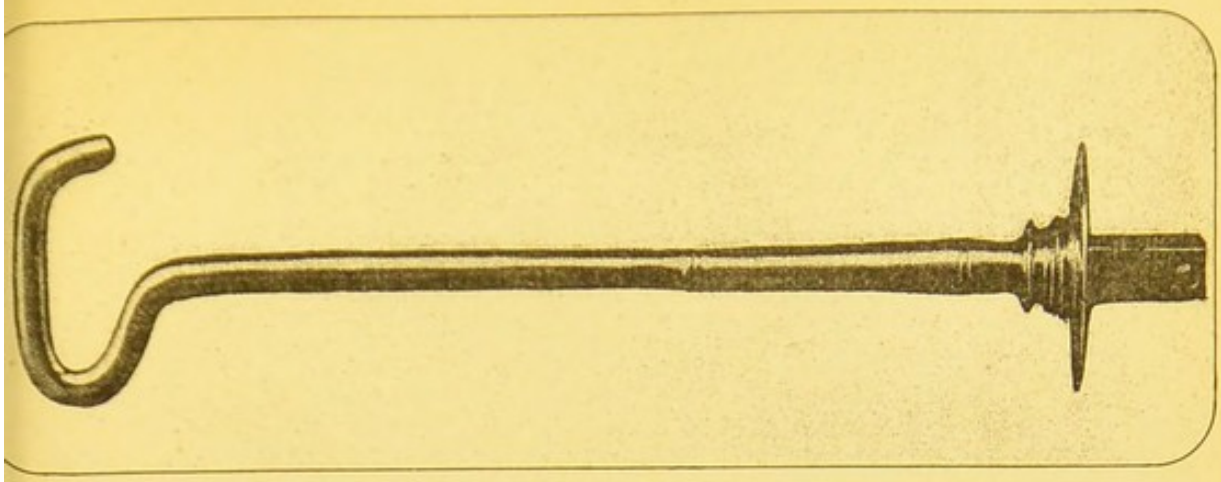
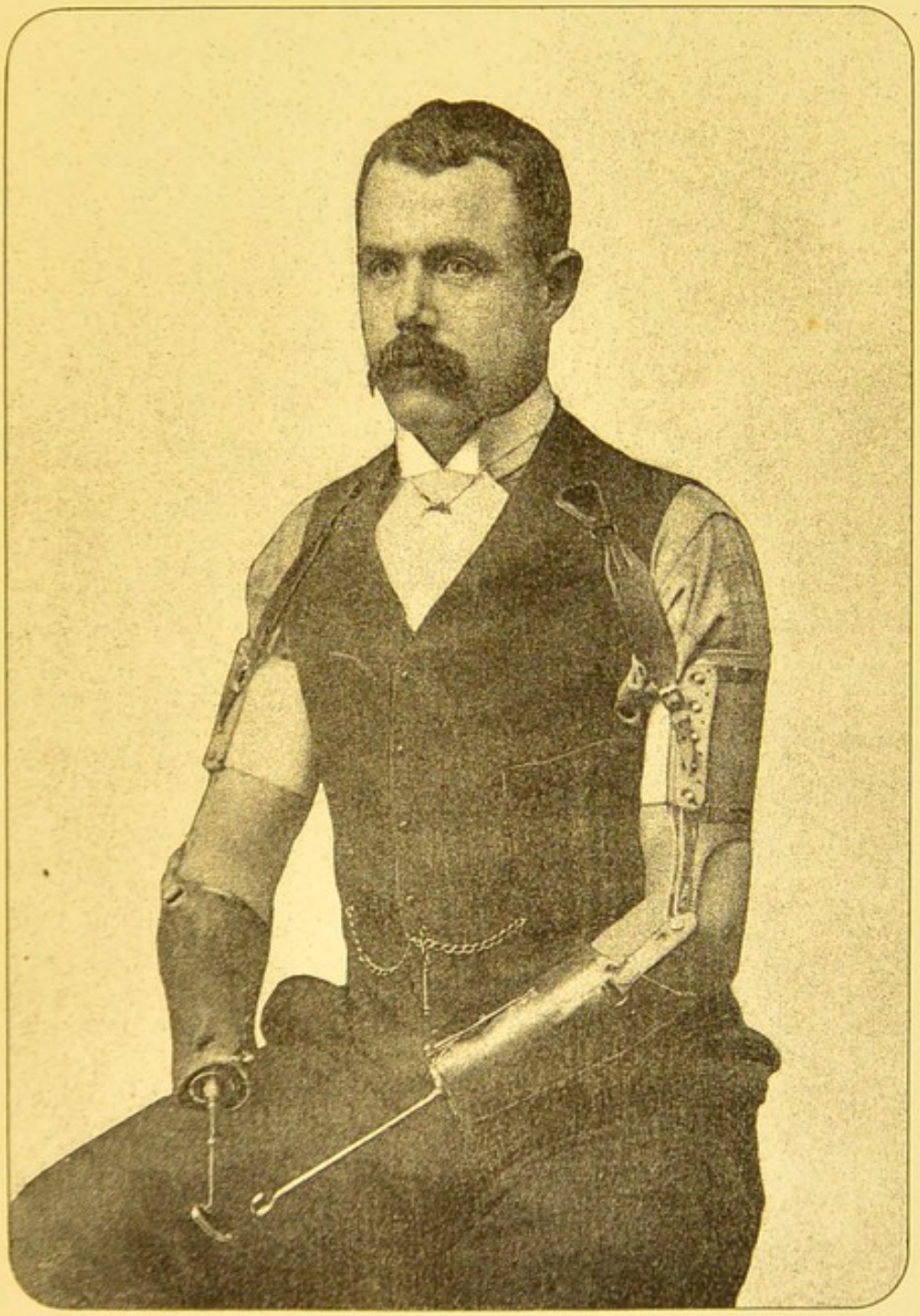


Fig. 26.



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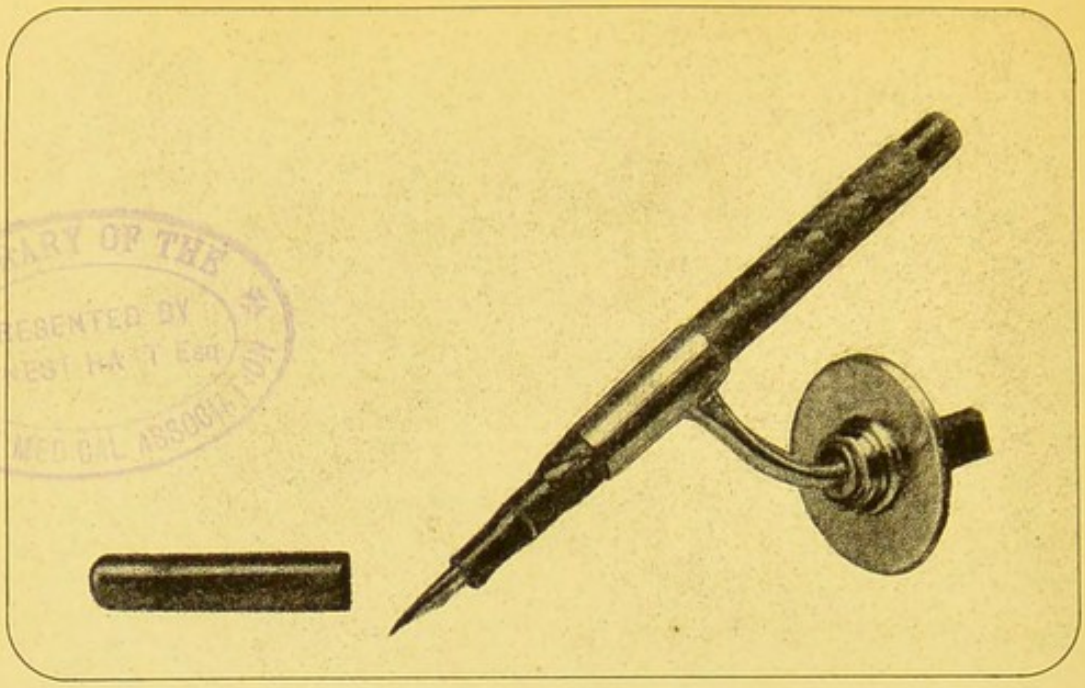

Fig. 28.

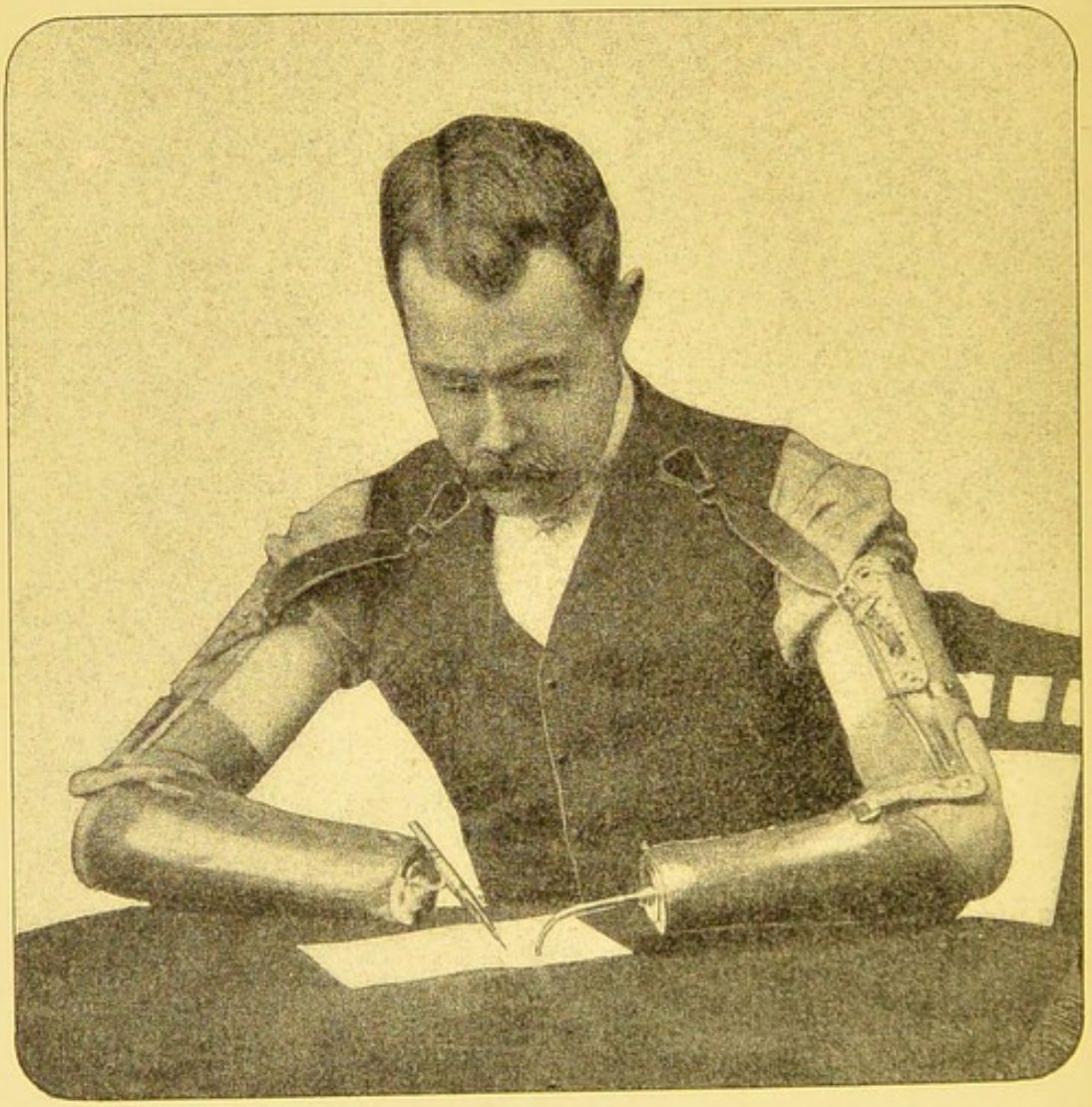

Fig. 29.

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Jan 13. 93

Dear Mr. Ernst

I have much pleasure in writing you a few lines with your own apparatus to show you how I am progressing and feel sure you will at once observe the great improvement.

Yours faithfully

J. C. L.

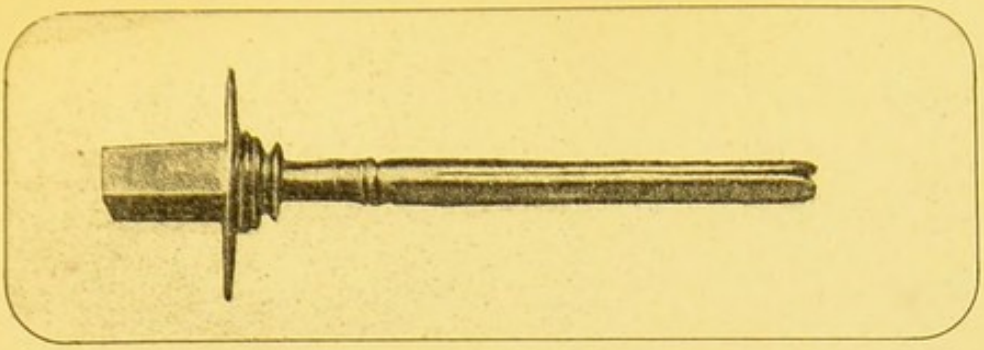

Fig. 30.

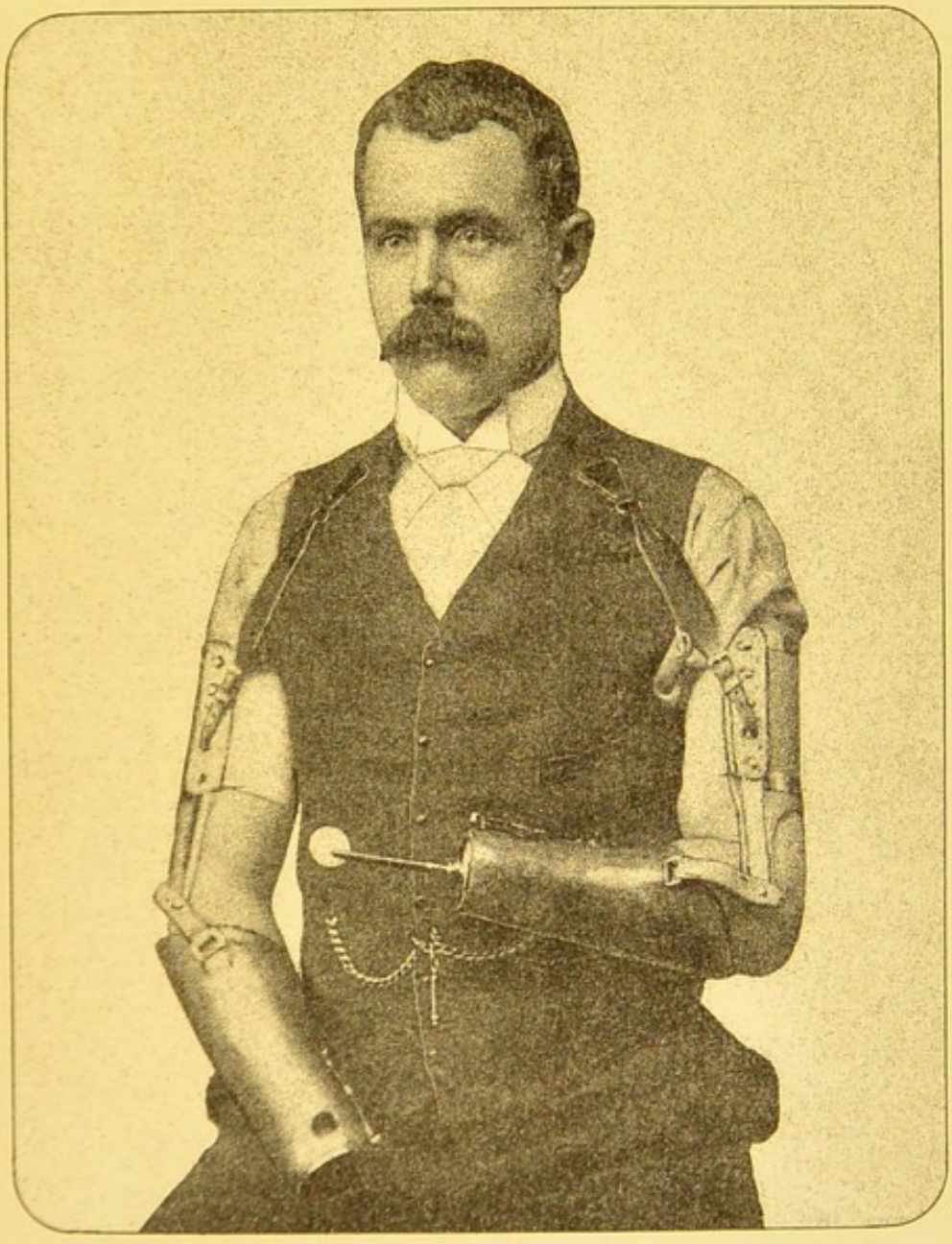

Fig. 31.

[illegible] PHOTO. [illegible] & CO. LONDON.

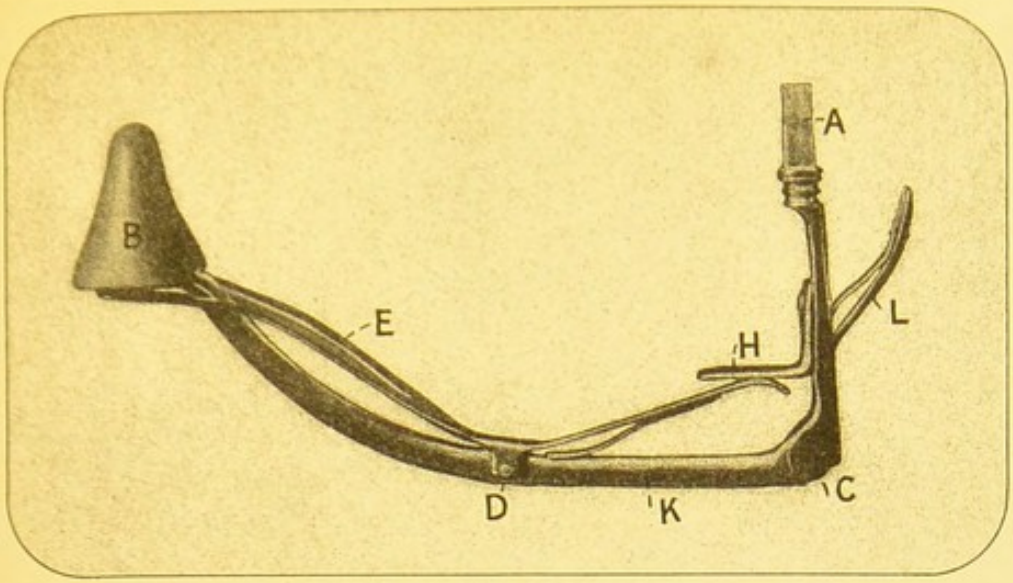

Fig. 32.

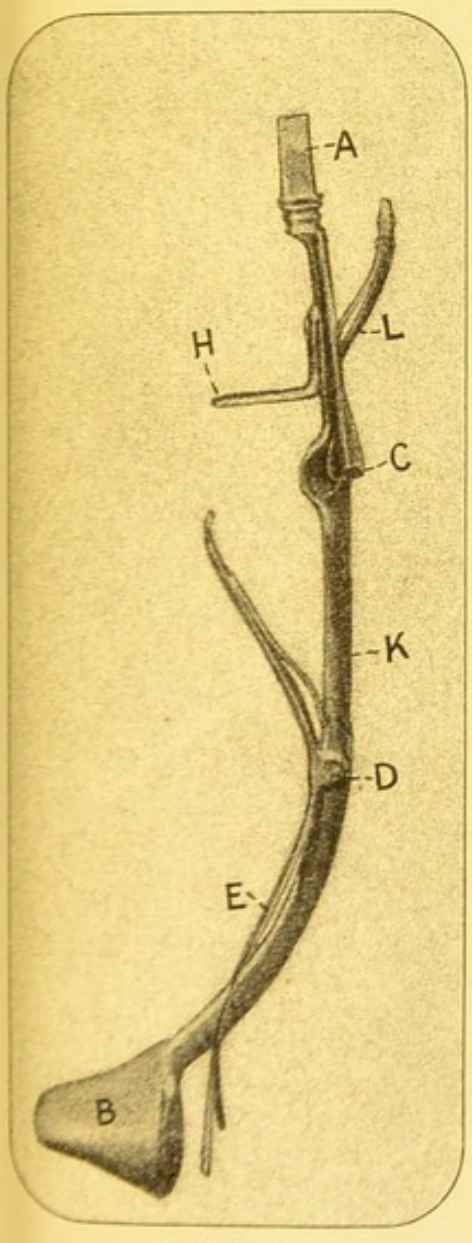

Fig. 33.

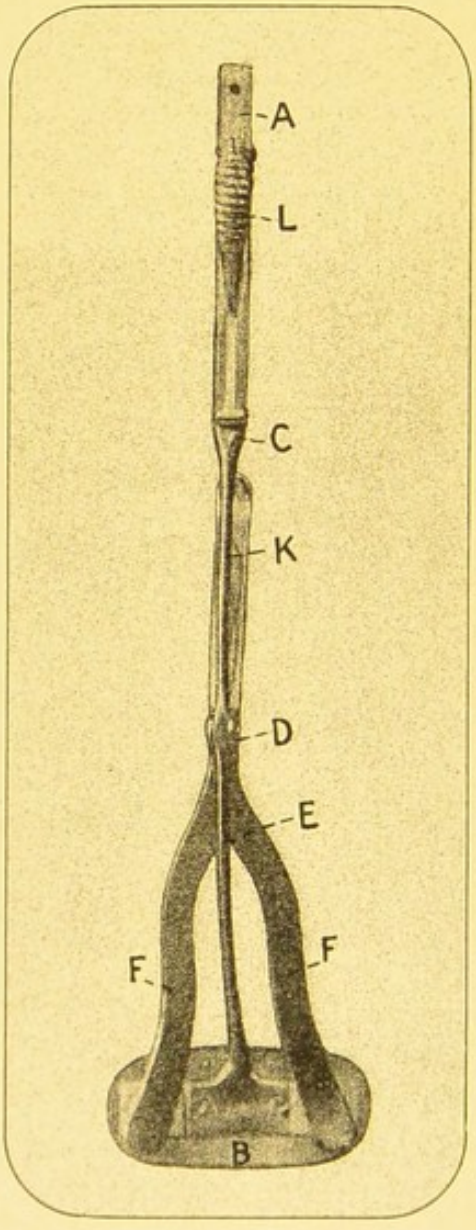

Fig. 34.

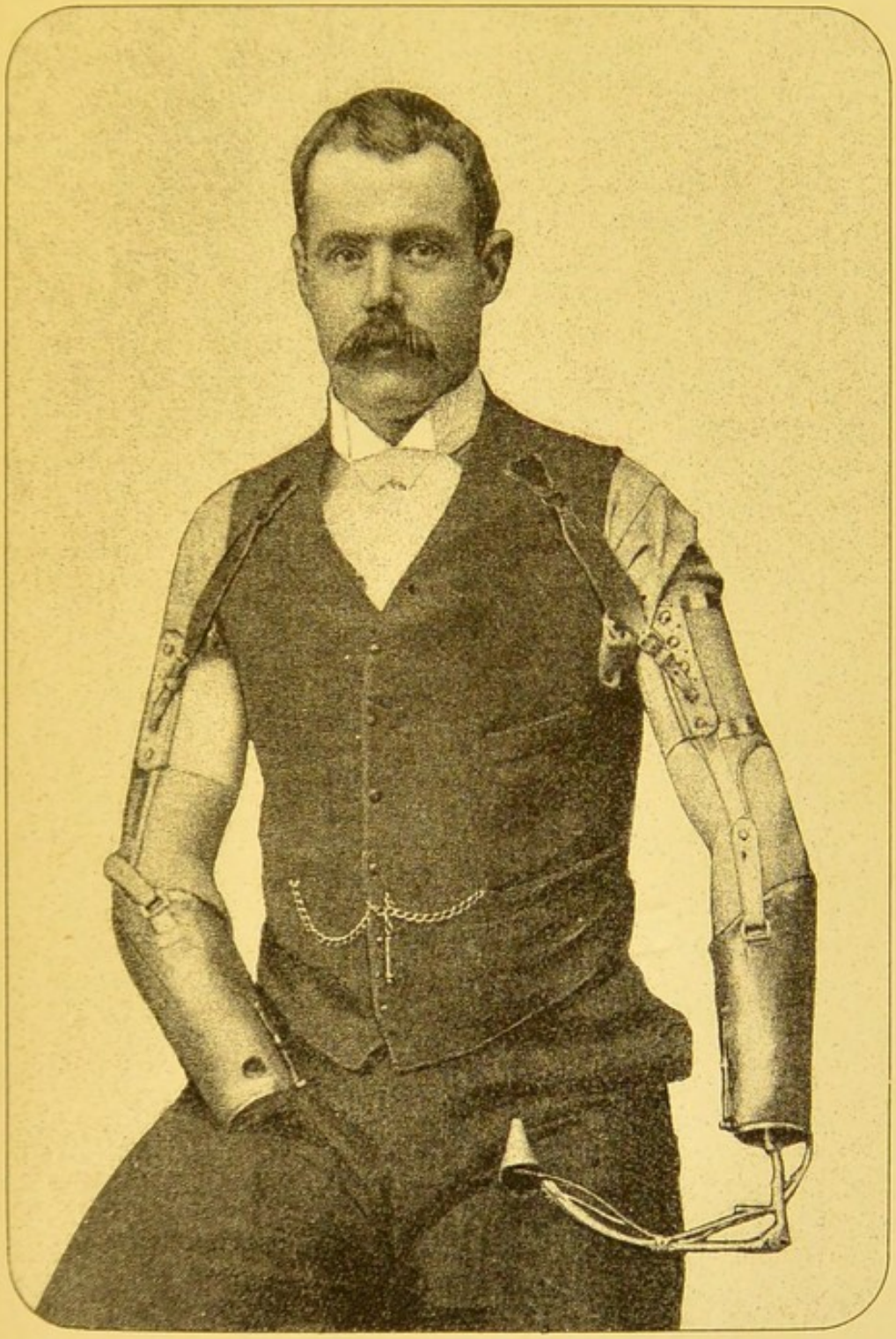

Fig. 35.

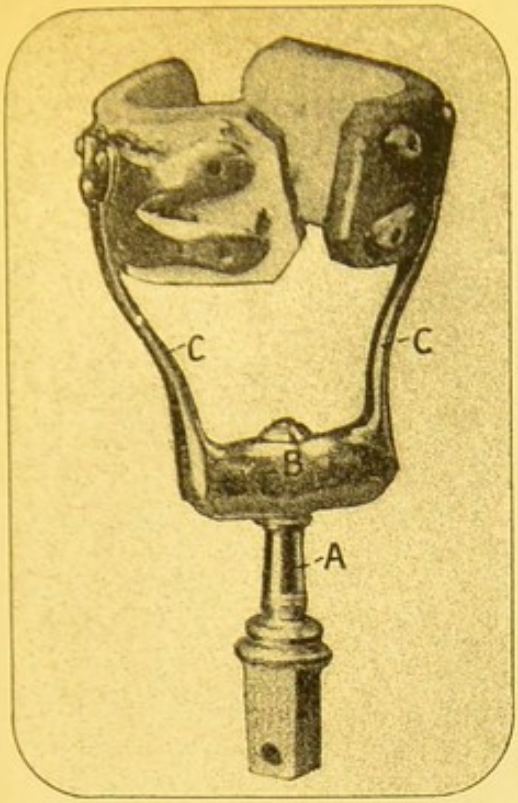

Fig. 37.

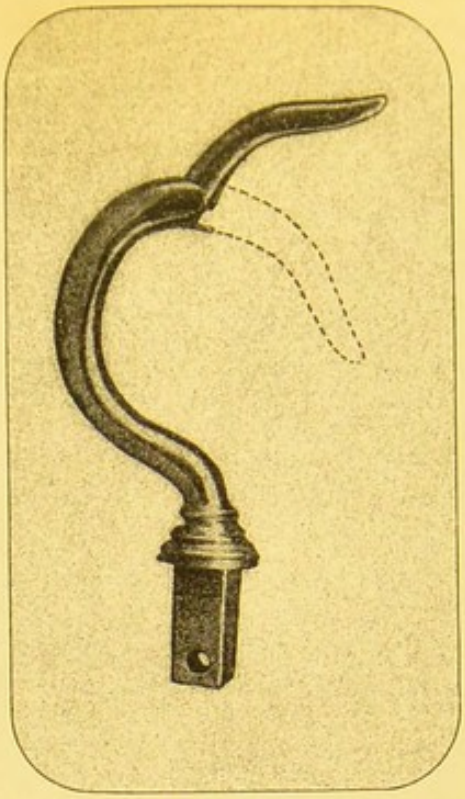

Fig. 36.

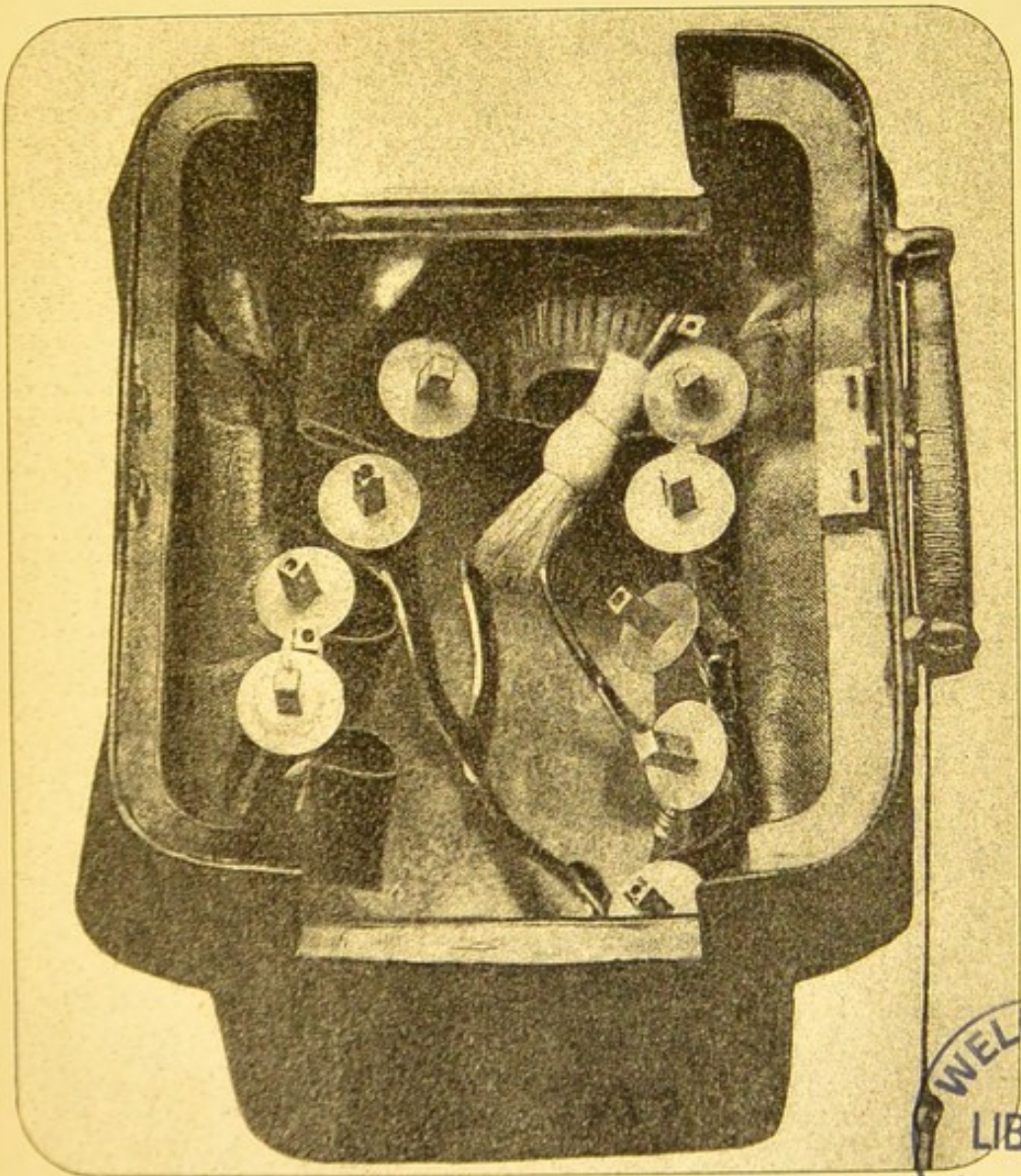

Fig. 38.

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