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A SURVEY OF PORTABLE
EQUIPMENT IN DENTISTRY

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A Thesis submitted in partial
requirement for the
DIPLOMA IN PUBLIC HEALTH DENTISTRY

Department of Preventive Dentistry
Faculty of Dentistry
University of Sydney
1972

VOLUME 1

"Man should not be forced to adapt himself to work, Work should be adapted to him. The human machine should be comfortable while working. Never forget the whole man. The human abilities and needs should be considered along with the machine's abilities."

R. LEHRER

PREFACE

Fifteen to thirty years ago dentists rarely left their surgeries to treat patients. People who could not make regular visits to a dental surgery learned to bear their dental troubles or, at best, received care for emergencies only. Recently, the dental profession has set new goals to achieve more and better care for homebound, bedridden, and isolated patients. Dentists now are contributing their professional skills and leadership to gain complete dental care for such handicapped individuals. Efficient, acceptable and portable equipment is an important adjunct for meeting this challenge. Organisations such as nursing homes, hospitals, public dental clinics, schools and armed forces provide examples in which field units can be useful.

Portable equipment formerly, was heavy, cumbersome, and inefficient. It did not compare favourably with that used by the dentist in his surgery because much of it was difficult to manage other than in performing the simplest treatments. Dentists avoided needed programmes, because of the unfavourable working conditions. Poor lighting, inefficient cutting instruments, lack of vacuum systems, lack of X-Ray machines and poor facilities for sterilizing instruments have hampered such out-of-clinic treatment.

The need to take treatment to the patient and the current interest in methods of dental practice have prompted a review of portable dental equipment - the types and trends in design. (1)

ACKNOWLEDGEMENTS

The author wishes to acknowledge the guidance and advice, in writing this thesis, by Professor N.D. Martin, M.D.S., F.A.C.D., F.A.C.D.S., F.A.P.H.A., F.I.C.D., A.I.A.O.P., Dean, Faculty of Dentistry, Associate Professor P.D. Barnard, M.D.S., M.P.H., F.A.C.D.S, Department of Preventive Dentistry, University of Sydney and Mr. R.A. Harris, M.B.E., M.D.S., F.A.C.D.S., Director, Institute of Dental Research.

Also, to Mr. P. Ward and Miss B. Bischoff, Photographic Department, United Dental Hospital, for their very valuable assistance with the photographic references.

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1. INTRODUCTION

Following the nineteenth century there has been a steady improvement in the efficiency of chairs, cabinets and engines. Equipment dealers and their employees became architects, interior decorators, efficiency experts and sales psychologists, and the average dentist accepted them at their word. (2)

The dental profession is now in the midst of a technical revolution. As in the field of medicine this technical revolution centres about the proliferation of machines, tools, associated techniques, and new data to aid diagnosis and expedite therapy. (3)

The art and science of dentistry as administered to a community, is subject to the pressures of technological advances. It is inevitable, therefore, that we see constant change in the armamentarium essential for the practice of dentistry as currently interpreted.

New materials, new alloys and new concepts have been combined to provide the dentist with various opportunities to facilitate his work. The institution of these changes often depends upon a circumstance which in a forceful fashion, highlights deficiencies in existing methods. Probably the advent of the high-speed rotational cutting techniques with the need for adequate coolant was the major catalyst in producing many of the changes that are now with us.

Another focal point of change has been the concentration of effort in helping the patient to cope with the emotional reactions he experiences when undergoing operative or

surgical therapy. A great deal of attention has been given to the provision of an environment conducive to relaxation in order to reduce the tension associated with treatment.

It is therefore admirable that considerable effort is currently being expended in providing and organizing the dentist's surgery facilities so that not only can the patient be put at ease but the work of the dentist and his chair-side assistant can be lightened. (4)

The practice of dentistry can be considered to consist of three elements.

1. Patients
2. Equipment
3. Dentists

"Equipment" has, on purpose, been interposed between "patients" and "dentists" because, dental equipment, in its broadest sense, is the catalyst that allows the dentist to use his skill and knowledge for the benefit of the dental profession's "raison d'etre", the patient.

2. HISTORY

Ever since Pierre Fauchard, many practising dentists have felt the need for a rotary appliance to help them in their work. Some used their inventiveness and skill to produce a variety of so-called dental drills, a number of which can nowadays be seen and admired in many a dental museum. In spite of their ingenuity, almost all of the early instruments had to be used with two hands; all of them were inefficient. The first really efficient rotary appliance was patented by Dr. James Morrison on February 7th, 1871, that is just over 100 years ago. (5) Figure 1.

In order to perform fatigue-free, long duration treatment, Coleman in 1880 proposed treatment of the patient in a supine position while the dentist sits. For this purpose, he used the "Wilkinson Operation Chair" and a supporting stool which could be adjusted in its height and slope. To keep the field dry, he used a saliva ejector and cofferdam. All the instruments required for treatment were to be placed on a mobile side table and then be brought as close as possible within reach of the field of operation.

Strauss in 1874 and Lawrence in 1879 already tried to start the dental engine with water, air, and compressed gases. In 1928, 60,000 r.p.m. were attained with a water-driven turbine made in the U.S.A. The Siemens Co. in 1957 constructed an air-driven turbine which attained 100,000 r.p.m.

In connection with the striving for simplification of industrial work, Balters published his point of view concerning professional qualifications, work flow and simplification of work in a series of booklets and articles. He initiated concepts such as "time and space-saving" and

"space-timing shortest movements". For simplification of work he initiated analysis of work flow and work environment. His ideas have been incorporated in modern dental equipment design. (6)

The basic design of Morrison's dental foot-engine has changed very little, as shown in Volume 11 of this thesis.

Plates 1 and 2 show a dental foot-engine being used by a Royal Australian Air Force Dental Officer at Morotai, Netherlands East Indies in 1944. The Dental Officer has ingeniously adapted a small electric motor from a crashed Japanese aircraft to supply power to the driving wheel.

Plate 3 shows this type of simple foot-engine which was used in mobile dental units of the U.S.Navy during the World War 11, and Plate 4 shows the unit as used during the Korean War, 1950-53.

Plate 5 shows the latest Kavo mobile foot-engine with electric-motor which can be used as circumstances demand. It is currently being used by the Australian Armed Forces. (Figure 2)

Morrison's foot-engine was the first of a long line of effective mechanical aids for cavity preparation and the many other processes for which a rotary tool is of use to the dentist. It encouraged the employment of electrical power for rotary dental appliances and a number of the many types of electric motor which were invented during the two decades following its introduction were used to drive Morrison's foot-engine or modifications of it. It made possible the development of many forms of handpiece and of special attachments such as those for condensation of gold foil, for amalgam packing, for gingival massage, and for laboratory purposes of many kinds. These handpieces became the forerunners of the present-day air turbines and electric micro-motors which, in fact, employ principles that had been tried by George Green in his engine driven by a "little windmill" and his "electrical burring engine" both of which he produced in 1870.

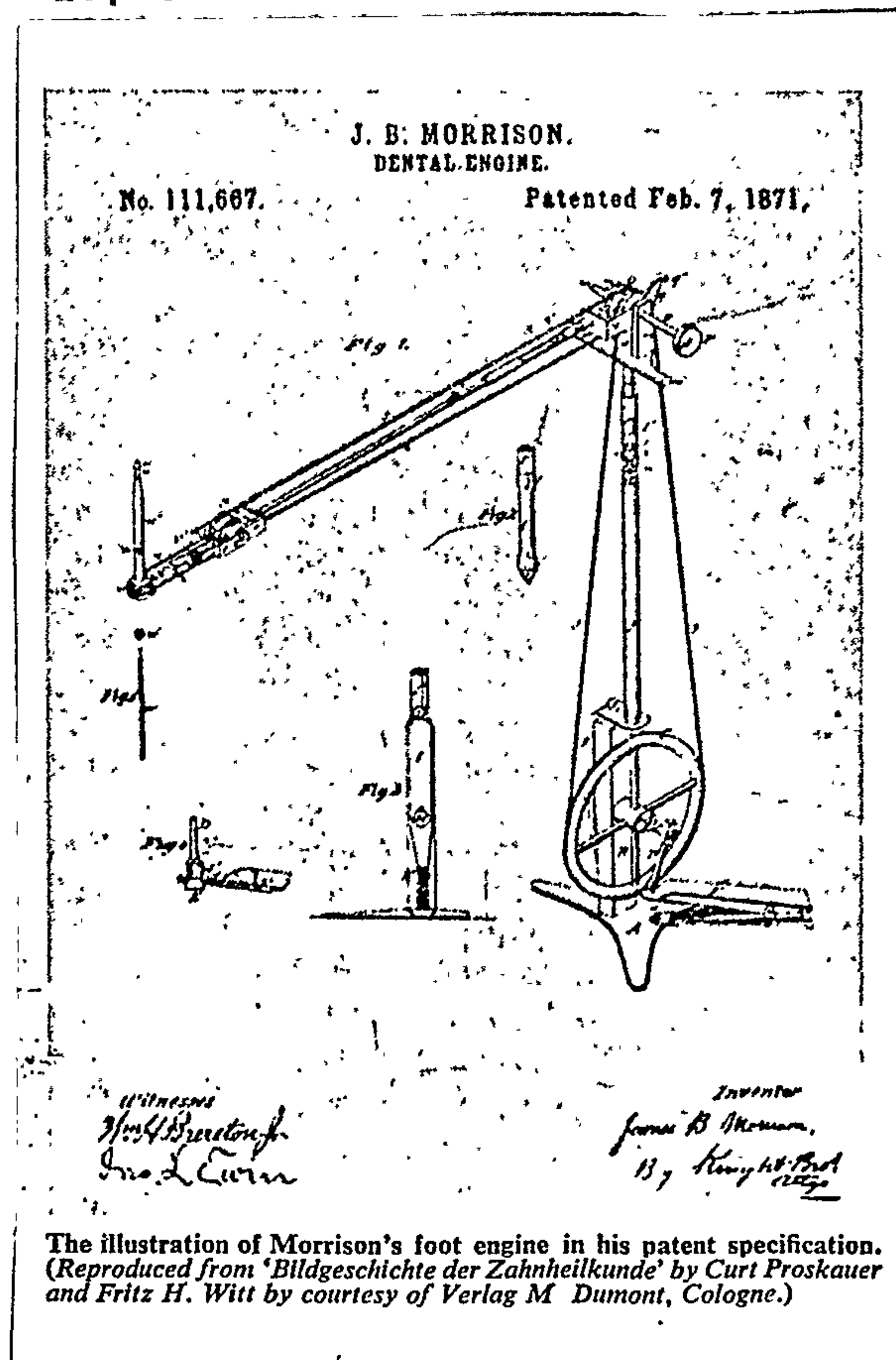


Figure 1.



KaVo Table and Floor Model Engines

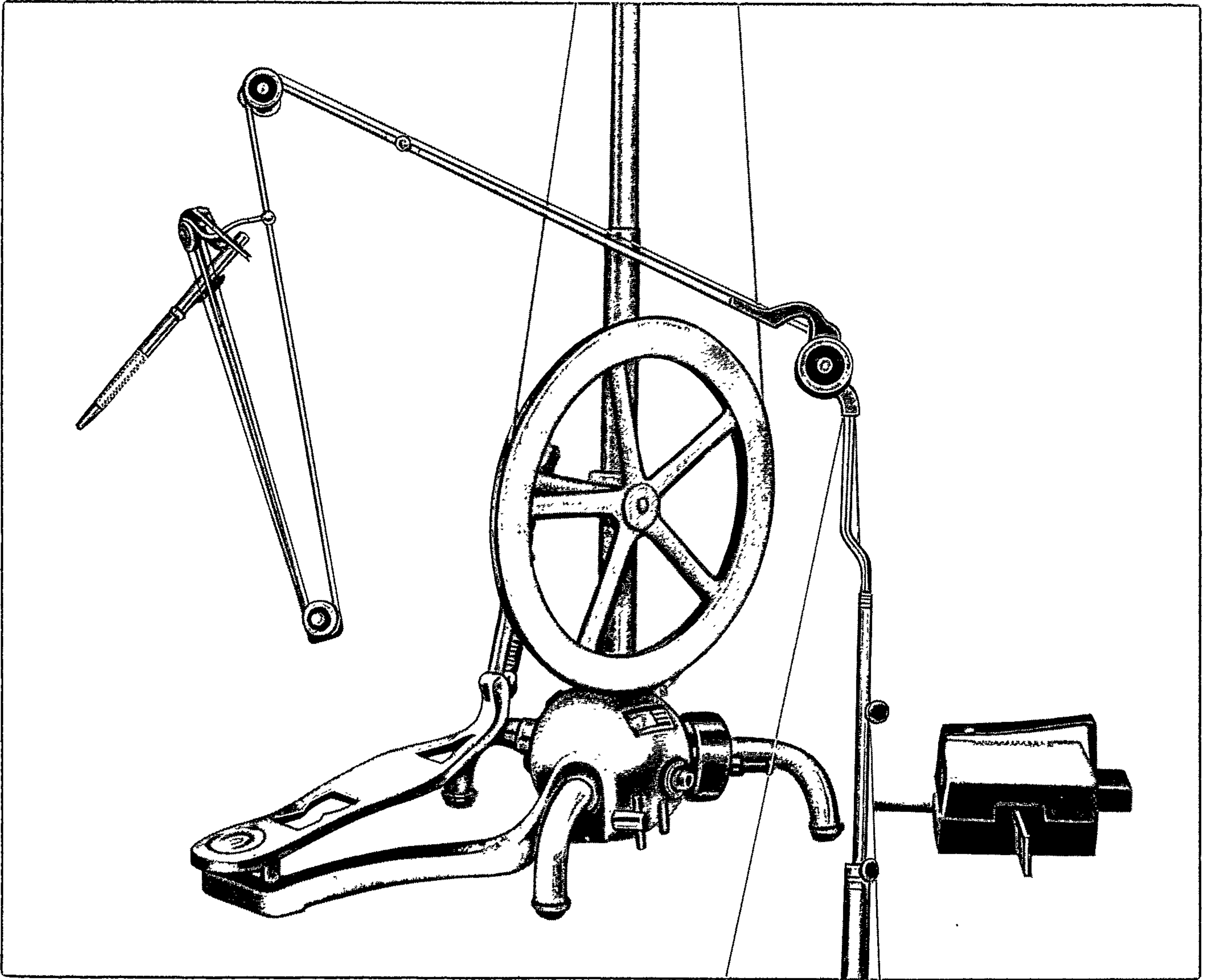


Figure 2.

3. THE REQUIREMENTS FOR PORTABLE DENTAL EQUIPMENT

There is a requirement for portable and mobile dental equipment for the simple reason that certain patients are unable to visit a fixed clinic or surgery. Therefore the dentist must go to the patient, taking his equipment with him.

The reasons for this situation are:-

1. Geography
2. Incapacity
3. Occupation

1. Geography - Demography

Australia has a population of approximately 13,000,000 people in an area of 3,000,000 square miles. There is a ratio of one dentist for every 2,562 of the population. (7)

However this does not give a clear picture of the distribution of dentists to the area of the country. As shown in Table 1 Australia has a very high percentage of urban population, increasing from 82.91% in 1966 to 85.55% in 1971. (8)

There are large areas of Australia with scattered rural populations, even towns up to 2,000 people with no resident dentist. Figure 3 gives the density of population for the Commonwealth in 1961. (9)

An example of the problem is the State of New South Wales. It is a large state of 309,433 square miles and at the census taken on 30th June, 1966 had a population of 4,231,000, making it the most populous state in Australia. Vast areas are thinly peopled but there is a very heavy concentration in and around the seaboard cities.

An analysis of the Register of Dentists for New South Wales in 1966 reveals the following dentist population ratios:-

- URBAN CENTRES : NUMBER AND POPULATION IN GROUPS OF VARIOUS SIZES : AUSTRALIA.

Population size of urban centres	Census, 30 June 1966			Census, 30 June 1971		
	No. of urban centres	Population	Proportion of Australian population %	No. of urban centres	Population	Proportion of Australian population %
500,000 and over	5	6,500,547	56.04	5	7,372,085	57.92
100,000 - 499,999	4	620,705	5.35	5	837,041	6.58
75,000 - 99,999	1	92,311	0.80	..	..	..
50,000 - 74,999	5	279,031	2.41	5	320,721	2.52
25,000 - 49,999	6	205,983	1.78	12	407,598	3.20
20,000 - 24,999	11	246,891	2.13	8	177,438	1.39
15,000 - 19,999	16	269,449	2.32	16	275,944	2.17
10,000 - 14,999	18	214,369	1.85	22	259,531	2.04
5,000 - 9,999	62	450,173	3.88	66	466,385	3.66
2,500 - 4,999	101	351,765	3.03	108	372,828	2.93
2,000 - 2,499	51	112,983	0.97	53	117,670	0.92
1,000 - 1,999	178	253,923	2.19	181	259,054	2.04
Less than 1,000 (a)	27	18,873	0.16	35	22,340	0.18
TOTAL URBAN POPULATION	485	9,617,003	82.91	516	10,888,635	85.55
500,000 and over	5	6,500,547	56.04	5	7,372,085	57.92
100,000 "	9	7,121,252	61.39	10	8,209,126	64.49
75,000 "	10	7,213,563	62.19	10	8,209,126	64.49
50,000 "	15	7,492,594	64.59	15	8,529,847	67.01
25,000 "	21	7,698,577	66.37	27	8,937,445	70.22
20,000 "	32	7,945,468	68.50	35	9,114,883	71.61
15,000 "	48	8,214,917	70.82	51	9,390,827	73.78
10,000 "	66	8,429,286	72.67	73	9,650,358	75.82
5,000 "	128	8,879,459	76.55	139	10,116,743	79.48
2,500 "	229	9,231,224	79.58	247	10,489,571	82.41
2,000 "	280	9,344,207	80.56	300	10,607,241	83.33
1,000 "	458	9,598,130	82.75	481	10,866,295	85.37
TOTAL URBAN POPULATION	485	9,617,003	82.91	516	10,888,635	85.55

(a) Urban centres classified as such on grounds other than population and density.

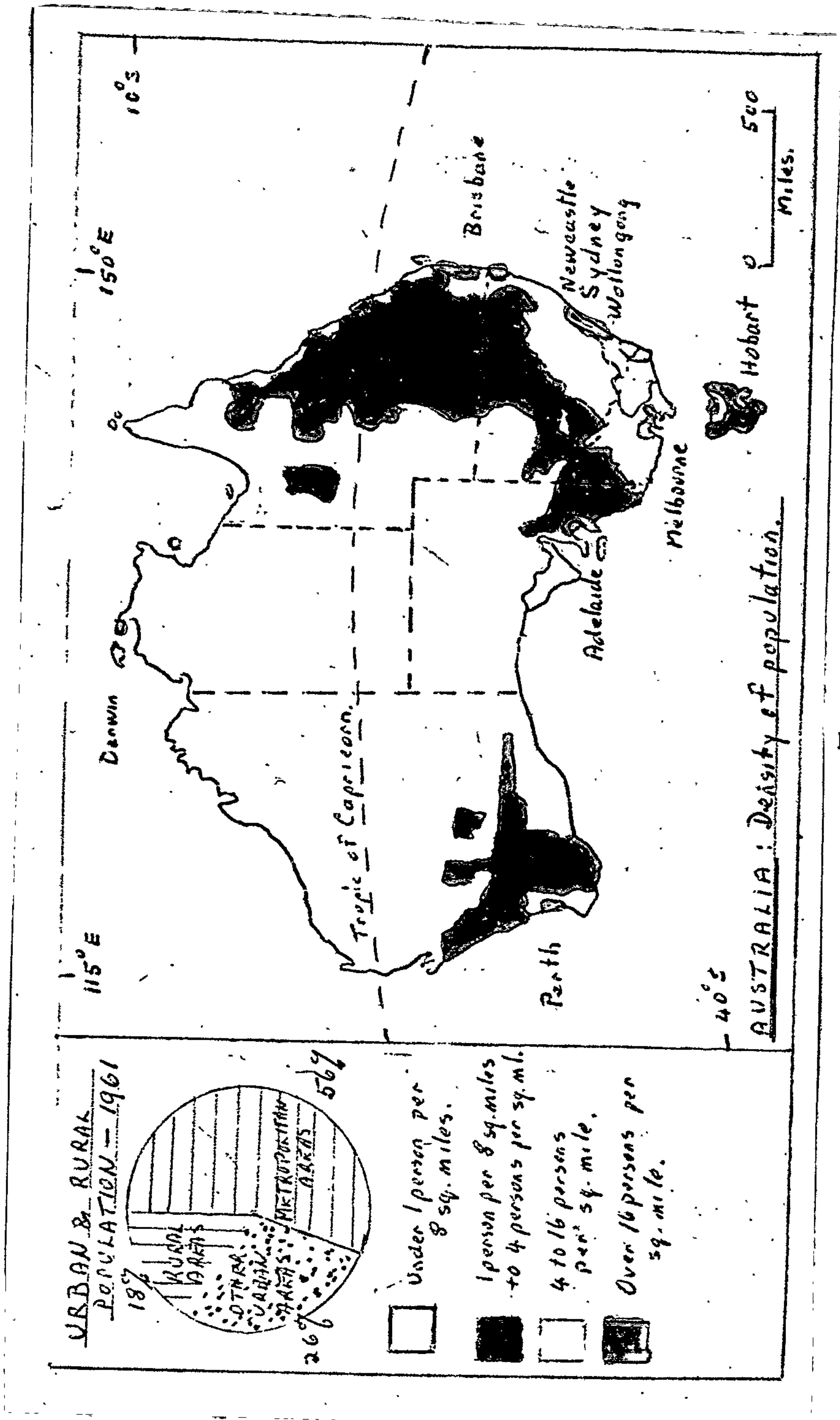


Figure 3.

Sydney	1 = 2,333
Newcastle	1 = 3,835
Elsewhere in N.S.W.	1 = 4,032
N.S.W. overall	1 = 2,917

There is a mal-distribution, rather than a shortage of dentists. The three cities of Newcastle, Sydney and Wollongong with a total population of 2,841,500, are well served with dental facilities, both private and public. Dental services in the central third of the state vary considerably from district to district. Some towns have inadequate or non-existent dental services.

A somewhat different position prevails in the area comprising the western third of the state. This is the driest section of N.S.W. and apart from the city of Broken Hill (pop.30,000), is populated by only relatively small scattered communities. Other communities in the far west of the area including the principal centres in the Central Darling Shire are catered for by departmental dentists travelling with the Royal Flying Doctor Service.

To provide dental treatment for this vast area, a service called "The N.S.W. Western Shires Dental Service" was set up. Main surgeries were established in the base towns and smaller villages were served using mobile equipment.

Each dentist was provided with a panel van, however because of conditions and distances most transport was by chartered aircraft.

This service caters for the dental health of 0.88% of the population of N.S.W. living in an area of 24 per cent of the state. (Figure 4)

THE N.S.W. WESTERN SHIRES DENTAL SERVICE

An imaginative dental plan for sparsely settled areas

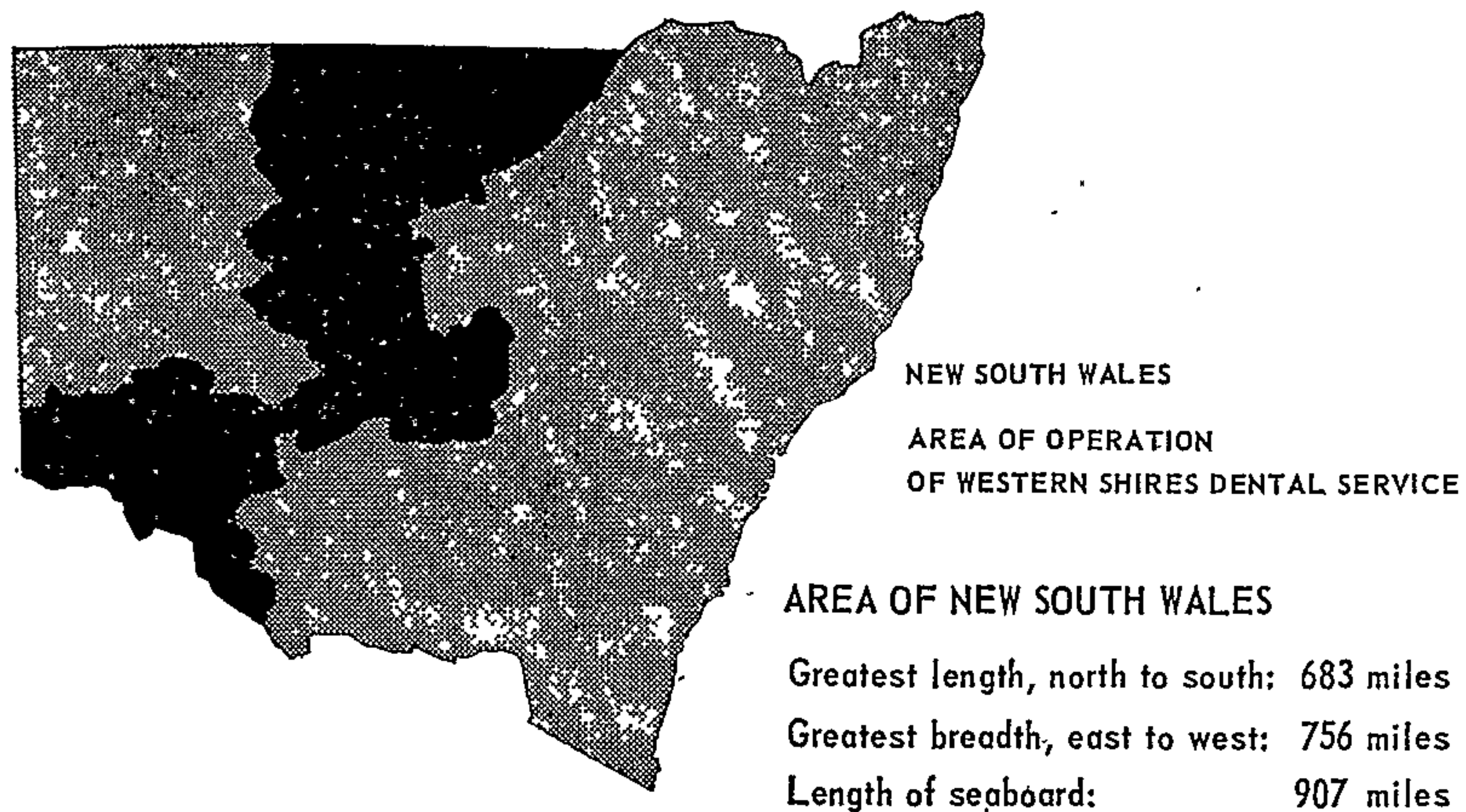


Figure 4.

In addition to this scheme, the United Dental Hospital provides a service for the country areas of N.S.W. with two Dental trains and a road caravan. Also, the Dental Division of the N.S.W. Department of Health provide static and mobile clinics, for the people of N.S.W. Both these services will be reviewed later in this thesis.

A further example of the geographic distribution problems in respect of dental services is the system operating in the State of Queensland.

Figure 5 shows the distribution of dental services in Queensland. These consist of base clinics, itinerant clinics and private surgeries. Some of these areas are serviced by air, sea and road as indicated in the legend.

The Public Dental Service of Queensland has 141 dental centres, staffed by 138 full and part-time dentists.

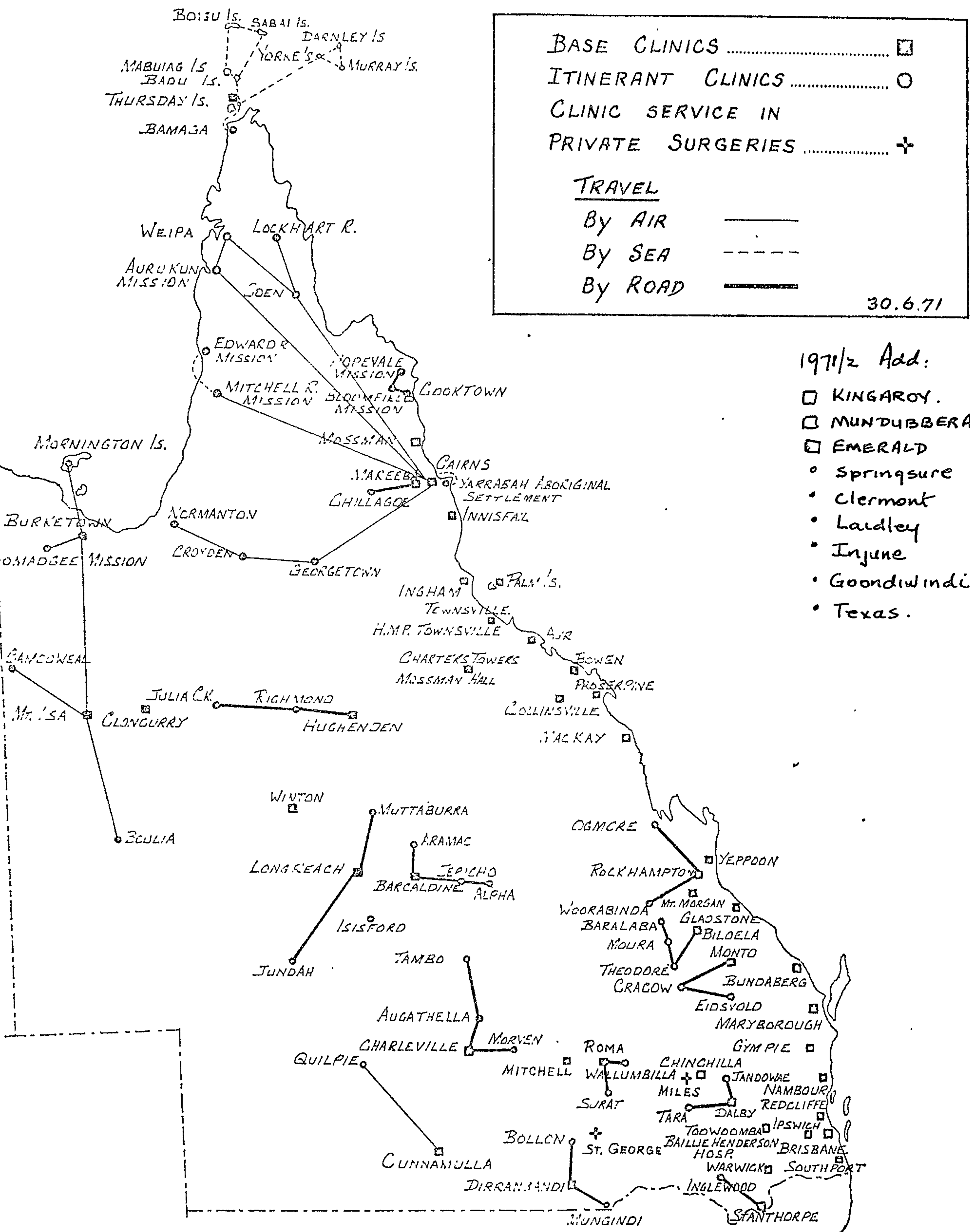


Figure 5.

The provision of dental services for the scattered population living in the vast outback areas of Queensland present a problem which was resolved with the utilization of Rail Dental Clinics. These Clinics operate from Cairns, Townsville, Rockhampton and Toowoomba and cover four lengthy inland rail systems. The Clinics are positioned at railway sidings. Should schools be situated at distances which prevent children attending rail clinics, Dental Officers travel to those schools and operate with portable equipment.

Portable dental equipment is specifically used in thirteen other areas, dental officers are provided with station sedans for travel. Dental Officers using portable equipment undertake dental procedures in schools where they establish temporary surgeries. (10)

The example of N.S.W. and Queensland are indicative of the problems in Australia of vast areas with scattered population requiring dental services which can best be given with portable and mobile equipment.

2. Incapacity

Many patients are unable to visit the dentist's surgery because of incapacity due to chronic illness, age, or being handicapped. In the United States there are an estimated 1,700,000 chronically ill or handicapped people, and many projects are underway to provide dental service for these people using portable equipment. (11)

In the U.S. one of the important developments of the '60's in the health care field has been the emergence of the hospital into the community as a centre for providing total health care service to many groups of chronically ill patients, as well as home care for many other long-term patients. (12)

3. Occupation

Many people are in occupations that make it impossible or inconvenient to attend static clinics. The nature of their work and the possibility of a limited time in a specific area may prevent the setting up of fixed clinics. Therefore, because the potential patients are mobile, the dental equipment to provide treatment must also be mobile and portable. The kinds of people to be considered here are many and various, and would include the Armed Forces, mining communities, cattle stations, missions, forestry works, off shore oil rigs etc.

4. CLASSIFICATION AND TYPES OF PORTABLE DENTAL EQUIPMENT

A. Classification - General

The present development of dental equipment elements and combinations, in connection with the ergonomical trends of dental practice administration, is like an explosion. The number of constructions is increasing rapidly. There are only very few experts with a broad knowledge of the technical and functional values of the different categories and types.

A dentist who selects new equipment to improve his efficiency must have some support, preventing the installation and use of wrong non-functional equipment combinations. Besides his ergonomical education he must have the possibility to compare the offered units, dental chairs, evacuation elements, working stools, cabinets etc., according to his concept.

The technical and functional classification planned by the Federation Dentaire Internationale and the International Standardization Organization is also based on these concepts. The realization of such a classification system will help the dental profession and its partners - the dental trade - to reach an overall view of the situation and to support better ways of construction, selection and use. (13)

The following groups of dental equipment elements will be included:-

- 1) Dental units
- 2) Dental chairs
- 3) Working stools
- 4) Evacuation elements and cuspidors
- 5) Cabinets
- 6) Tray elements
- 7) Dental operating lights

- 8) Sterilizers
- 9) X-Ray equipment
- 10) Special devices

B. Classification - Portable

In the last decade, the practice of dentistry has experienced something of a revolution in patterns of practice, in its simplification of tasks, and in its design of equipment. Field or extra-clinical dental practice also has been affected by these changes. Actually, most of the tenets of efficient dental practice today, can be applied in a field situation. The use of high-speed cutting instruments with a washed field and oral evacuation of high capacity, the effective use of assistants, the optimal placement of the patient, operator and instruments, all have advantages over traditional methods and can be adapted directly to outside treatment. When any interested operator wished to design desirable field-equipment then efficient methods of practice have to be a consideration, not mere mobility. Ideally, portable equipment should possess the characteristics now to be listed:-

- a) For portability, lightweight and highly mobile equipment is demanded.
 - b) For efficiency, the technology should compare with the best in permanent clinics.
 - c) For durability, one should be able to predict the minimum of breakdown and maintenance.
 - d) For flexibility, equipment ought to be adaptable to various situations and operators.
 - e) For simplicity, equipment must be easy to use, set up, take down, and repair.
 - f) For acceptability, it should be comfortable both during the use for the patient and for the clinician, with or without assistants.
 - g) For economy, the cost must be realistic.
 - h) For availability, sufficient production of units is demanded to ensure an adequate supply at all times.
- (14)

With these characteristics as a reference and using the F.D.I. classification, portable equipment will now be considered as separate types.

C. Types - Basic Items

1) Dental Units

Dental operating units assemblies may be classified as: fixed (floor mounted or cabinet mounted), Mobile (or stands with wheels, in mobile cabinets, and cantilevered) or chair-mounted (arm manifolds, back of chair assemblies, front-mounted on a telescopic arm). (15)

In general the instrument holder should fulfil the following requirements:

1. Hold all the instruments required by the operating team.
2. Place them where they can be reached without a strain or twist, either standing or sitting.
3. Receptacles should be angled towards the field of operation.
4. Turbine lines and saliva ejector should have easily engaged or disengaged tension relief holders to stop the "pull-back".
5. Gravity weights should "pull back" all lines to their receptacles when desired. Lines should be sufficiently long.
6. Automatic switch-over operating turbines should be equipped to prevent interruptions for switch or manifold changes.
7. When the operator is using a turbine, the assistant should be able to change to another turbine cutting tool, without stopping the turbine in use.
8. Instruments should have flexibility for arrangement according to frequency of use.
(Figure 6)

Dental operating units can be fixed to the floor of a caravan or trailer, mounted in rail-cars or positioned in ships. Portable units can be electrically operated, by either mains current or generators, gas operated, either by compressor or bottled gas. Specific types of units will be examined later in this thesis.

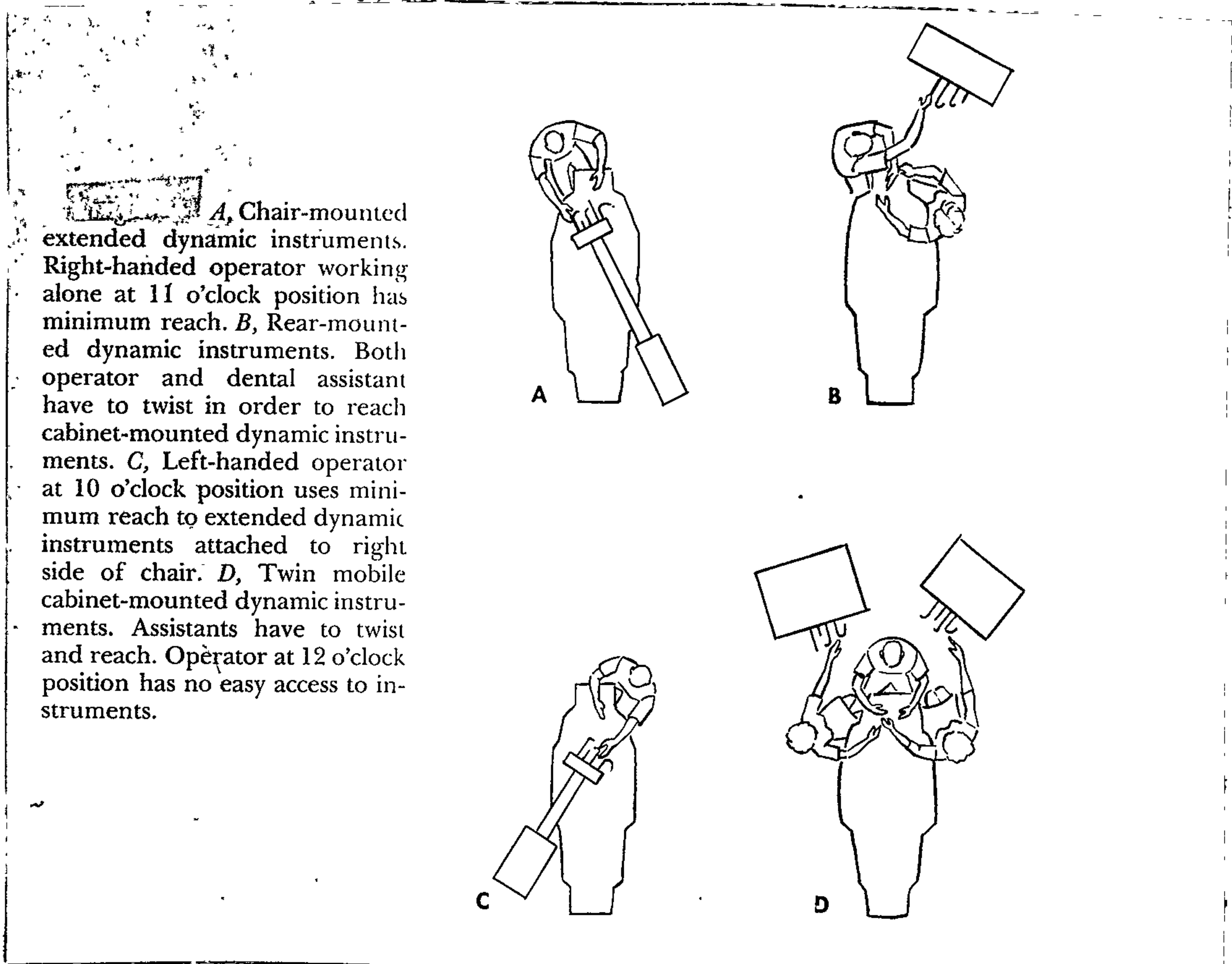


Figure 6.

THE DENTAL CHAIR

The presently available chairs encompass many categories for differing or similar functional areas. The uniting principle in almost all new chairs is the contour structure of the chair, upon which the patient may sit or lie. The foot-operated or motor-driven hydraulic chair of the old type, with movable headrest and typical seat, has disappeared from the catalogues of most manufacturers, or at least is not being promoted.

All new chairs should meet certain technical and functional criteria. Not all contour chairs provide the comfort necessary for rational practice methods. (16)

The following reference points should be kept in mind as requirements for any chair.

- 1) Orthopedically and physiologically appropriate position of the sitting or reclining surface.
- 2) Simple use, with special reference to cleanliness.
- 3) Simple positioning of the patient.
- 4) Complete freedom of movement for the dental team without inhibition by structural details.
- 5) Unencumbered functioning of the adjustments.
- 6) Solid construction.
- 7) Co-ordination of the chair with other equipment for the same functional area.

In evaluating chairs, the standing dentist and seated patient, the standing dentist and reclined patient and the seated dentist and seated or reclined patient, must be considered.

In all positions the prime objective is to bring the field of operation close to the operator so that he need not

accomodate himself to an ill-designed chair, stool, instrumentation system, and to poorly-located patient and assistant.

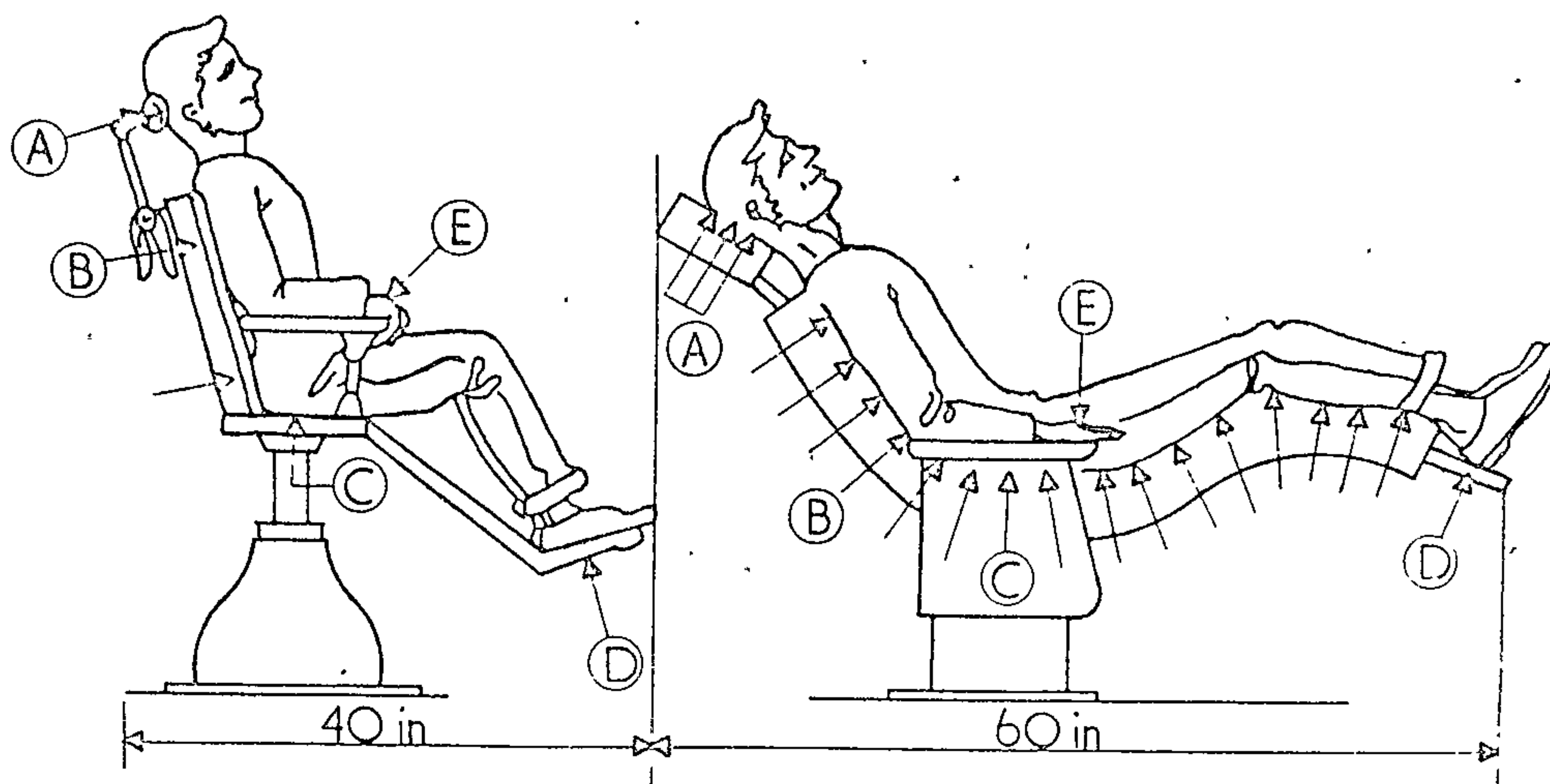
The dimensions for correct chair design should include the following: (17)

1. Height of seat from floor - 16 inches.
2. Seat angle - five degrees (front-end higher).
3. Seat length - 16 inches.
4. Curved seat front.
5. Space beneath seat for flexing legs.
6. Support for lower lumbar disks.
7. An open space of $4\frac{1}{2}$ inches at the lower portion of the back support for the posteriorly projected sacrum.
8. Adjustable shoulder support, at an angle of 105deg. to 115deg. from the horizontal.

The dental lounge chair must not only fulfil the requirements of a correct chair construction but also must allow the fully relaxed patient to be tilted in a Trendelenberg or a recumbent position.

To support both the patient's circulation and respiration, the contour configuration offers most benefit: (Figure 7)

1. The patient's legs are elevated, thereby supporting circulation.
2. The patient is "sitting", thereby supporting respiration and preventing choking and gagging.



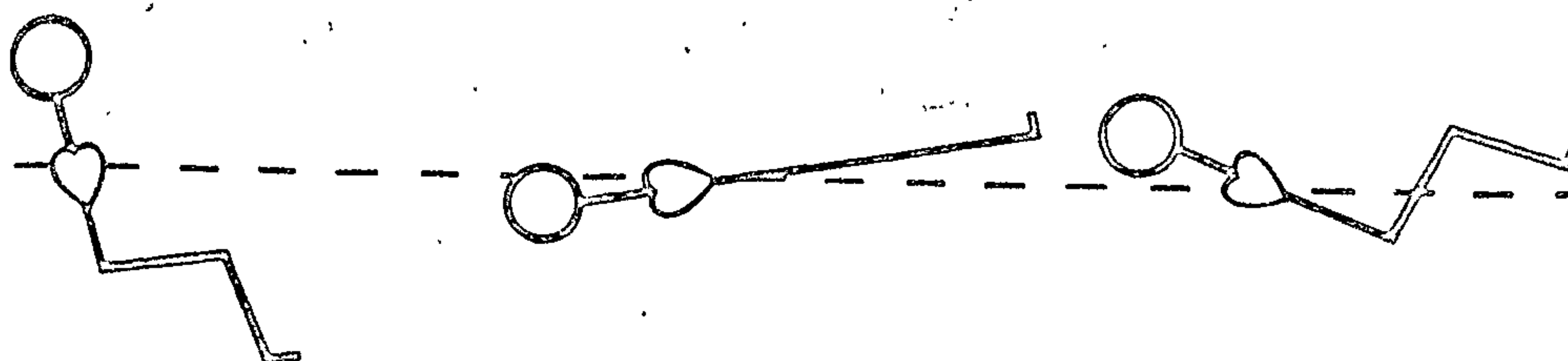
- A. Single point head support (fatigued neck muscles).
 B. Unequal back support (fatigued back muscles).
 C. Single point seat support.
 D. Foot support = pressure tension.
 E. Hand grip = pressure tension.

- A. Complete head support.
 B. Equal body weight distribution.
 C. Complete body support = relaxation.
 D. Heel support = no pressure tension.
 E. Arm support = no pressure tension.

FIG. 9.—Positions of the patient: A, patient fatigue occurs within 7 to 30 minutes when patient is upright; B, minor fatigue indications are present after 3 to 4 hours when the patient is in a semi-supine position. (From Golden, 1959.)

Figure 7.

3. Hospital beds are designed to assume this position, and it is used almost routinely after surgery to give maximum support to the patient.
4. Aerospace physiologists have discovered that astronauts withstand the most stress in this position. (18)



Three positions for patient in dental chair with heart as fulcrum: upright, Trendelenburg and contour configuration

Figure 8.

The contour configuration has proved an ideal solution. Sitting upright places the brain in the position most

susceptible to reduced blood flow. If this position is maintained after fainting, permanent brain damage or death could result. (Figure 8)

Experiments by Anderson (19) involved the redesigning and adaptation of a contour chair which gave complete support to the entire body, alleviating "tail-bone" pressures and blood vessel pressures by raising and supporting the legs and feet.

The bulk of the chair is materially reduced allowing the operator to seat himself under the back and headrest area and place the patient's head in the preferred working area.

A comparison of some lounge dental chairs are given. (Table 2)

These type of contour chairs are used by mobile dental clinics. (Vol.2, Plates 70,75,76) In other circumstances there may be a dual role for the dental chair.

Vol.2, Plates 7,8 shows that in a Royal Navy Warship, the dental chair is in the sick-bay and can be converted to an operating table if required.

The main problem arises with dental chairs when considering the entirely portable one. These types, if rugged enough, are too heavy, and attempts to make a light one have resulted in chairs that do not stand up to the heavy workload placed on them. The older type of collapsable tubular steel chairs do not adapt themselves to the modern concept of four handed sit-down dentistry. The various types of chairs available will be considered later in this thesis.

Chair (Lounge)	Power Features	Base Mobility	Controls
	seat back base knee flex synchro back & seat	rotate slide air cushion	hand foot base only auto. return dual opt. equip.
Belmont Supreme (Fig. 10)	x x x fix	x	x x x
Coastal Dynamics Medallion (Fig. 3)	x x x	x	x
Den-Tal-Ez (Fig. 11)	x x x	x opt. opt.	x base x
D.D.S., Mark I (Fig. 7)	x x x	x	x x x
Midwest So Lo (Fig. 6)	x x x	x x	x base x x
Relaxadent	x x x	x	x
Ritter Vega (Fig. 8)	x x x	x	x
Siemens (Fig. 12)	x x x	x	x x x
SSW Revelation	x x x	x	x x x
Scope (Fig. 13)	x x x fix	x	x x x
Vacudent Tempo	x x x	x	x x
Virginia La Siesta (Fig. 9)	x x x x	x x	x x x
Weber Multi Lounge (Fig. 14)	x x x	x	x x x
Reliance, No. 695 (Fig. 15)	x	x	x

Back	Oper. Range	Style Models	Hydraulic Electro Mechanical	Recl. Elbow Support	Material	Headrest
split one piece	low stroke	general thin ortho. pedo. surg.			leather vinyl nylon tricot	cushion prosth. rotate
x x	19.5" 10"	x	x		x	x x
x	22" 14"					x x
x x	16.5" 15.7"	x	x	x	x	x x
	13.5" 18.5"	x	x		x	x
x	13" 20"	x	x	x	x	x x
x x	10.5"	x	x	x	x	x
x	16.5"	x x	x		x	x x
x x	13"	x	x		x	x
x	16.5" 14"	x	x	x	x	x x
x		x		x		x
x x		x			x	x
x	18" 9"	x x	x	x	x x	x x
x	18.5" 15"		x		x	x x
x			x		x	x x

Table 2.

STOOLS

A dentist can increase his productivity through the use of auxiliaries, the application of time and motion principles, and the use of modern equipment. The latter method means sitting and providing a dental service efficiently and comfortably. Life insurance statistics reveal the life expectancy for a sitting dentist is 17 per cent greater than for the standing dentist. Industrial studies have shown that a seated worker uses 27 per cent less energy than a standing one. That can mean an eight hour day sitting, consumes as much energy as a six hour day standing. (20)

Most dentists use a seat height between 18½ and 22½ inches. Most dentists rarely changed seat heights but feel that easy adjustment was useful. To acquire a feeling of balance involves considering a stool that is right for the individual dentist. No stool is "best" for all dentists, each must make his own selection, together with the dental chair and unit. Table 3 gives a comparison of some available dental stools.

Operator's and Assistant's Stools

STOOL	ADJUSTABLE HEIGHT	ROUNDED	CONTOUR SEAT	ADJUST- ABLE BACK	STOMACH REST	BACK SUPPORT
		SEAT EDGE				
Den-Tal-Ez						
5 SSC	Spring & lock	Yes	Yes	Some	Yes	Yes
5RS	Spring & lock	Yes	No	Some	Yes	Yes
5SSB	Spring & lock	Yes	Yes	No	No	Yes
Dentsply						
(Operator)	Air Cylinder	Yes	Yes	Yes	Yes	Yes
(Assistant)	Air Cylinder	Yes	No	Yes	Yes	Yes
Palmero	Air Cylinder	Yes	No	No	No	Yes
Pedigo						
(Friction lock)		Yes	No	No	No	Yes
(Piano type)	Screw	Yes	No	No	No	Yes
Torit	Air Cylinder	Yes	No	No	No	Yes
Virginia						
(Operator)	Air Cylinder	Sewn	No	Yes	Yes	Yes
(Assistant)	Air Cylinder	Sewn	No	No	No	Yes

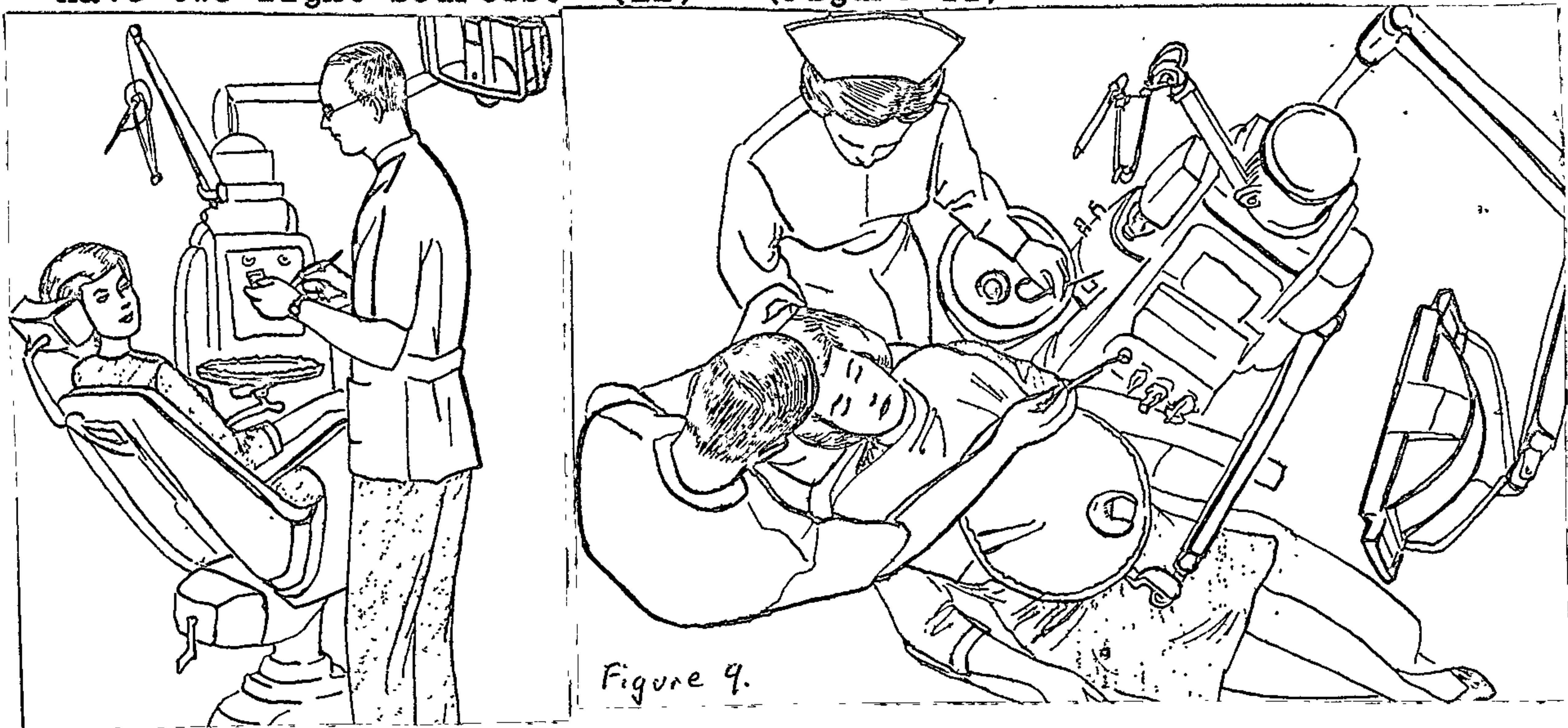
Table 3.

DENTAL OPERATING LIGHTS - CONVENTIONAL

Few other professions make such heavy demands on the eyes, as dentistry. Protection of eyesight is essential to a successful dental practice. Good vision requires a yearly ophthalmologic examination, improved office lighting, elimination of glare sources in dental offices, wearing of shatterproof prescription safety glasses while working, and office color schemes of non-glossy light greens or blues to reduce visual fatigue. (21)

For many years, the source of oral lighting has been predetermined by the fixed position of the headrest in the upright dental chair of some years ago. Because of this rigid position, the headrest necessitated the placement of the oral light directly in front of the patient, and the dentist working in a standing position beside the chair, was forced to permit the light to illuminate the work area over his right shoulder. Inaccessible regions of the mouth were illuminated by reflected light from the dental mirror. (Figure 9) The angle of the light beam to the patient's mouth varies according to the position of the patient's body. (Figure 10)

In the new concept of four-handed, sit-down dentistry, with the patient in a supine position, it may be necessary to have two light sources. (22) (Figure 11)



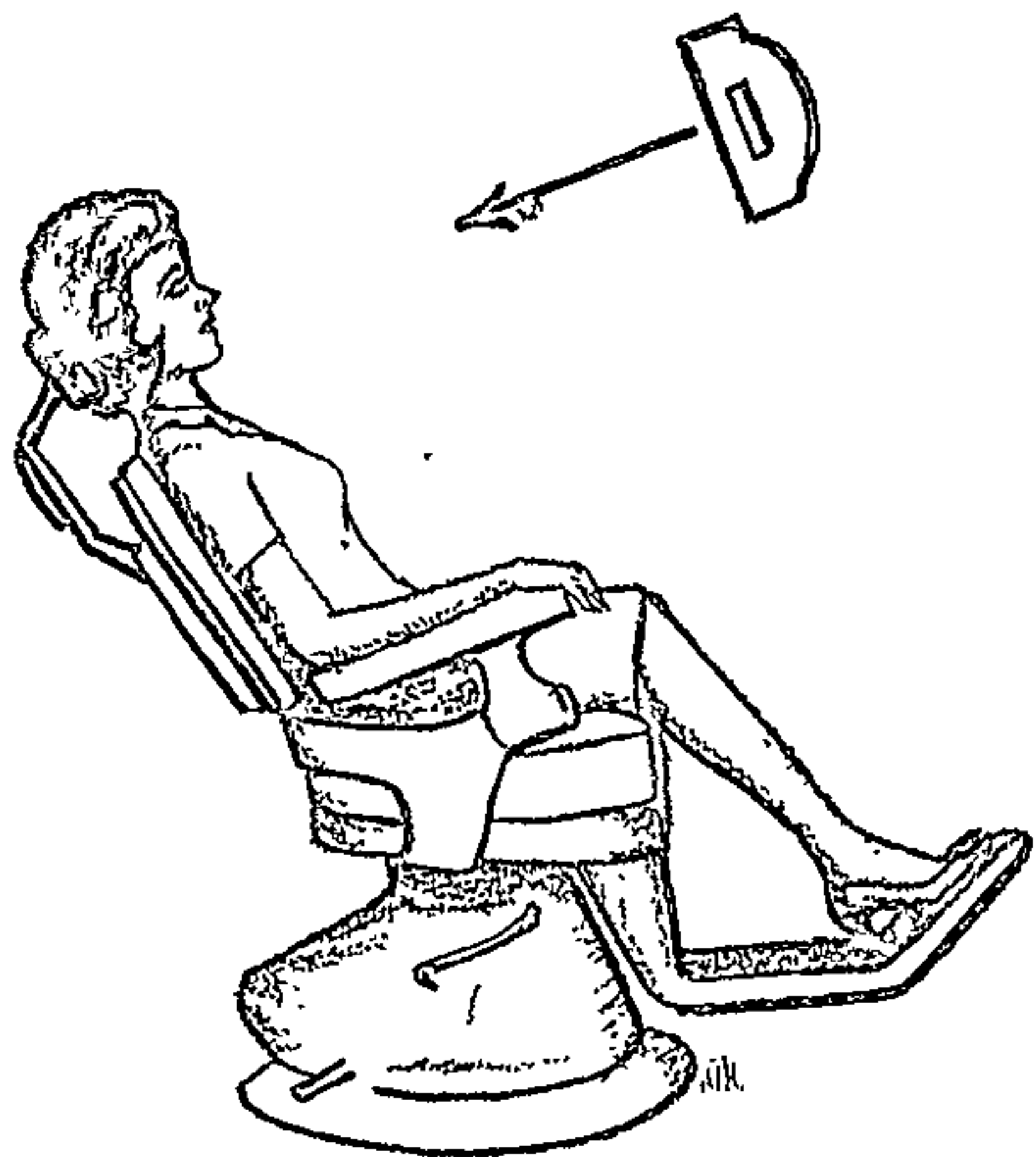


Fig. 3 • Patient in rigid upright seated position with light directly on face for dentist who operates in standing position

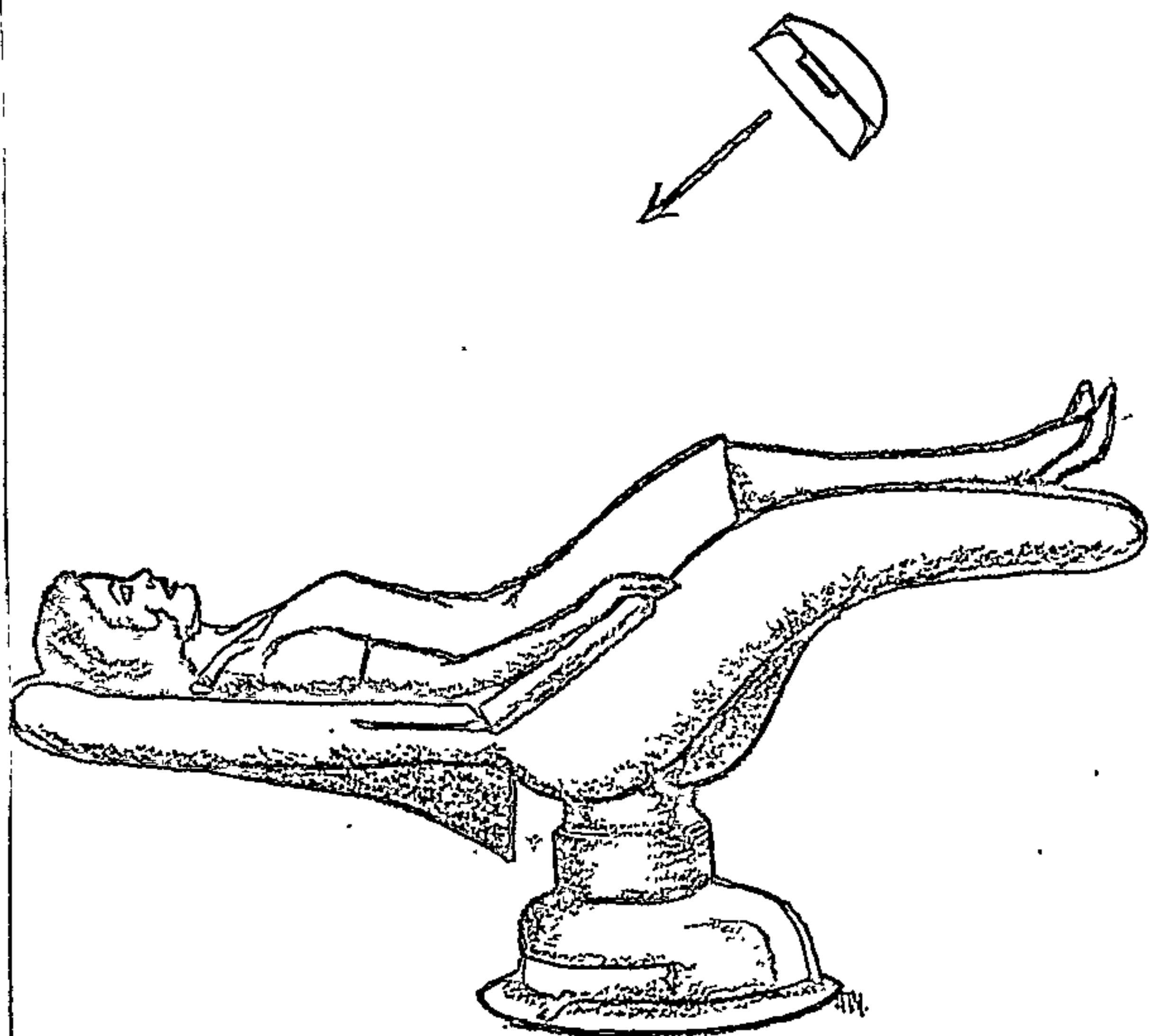


Fig. 4 • Patient in contour chair position for dentist who operates in seated position but with oral light inflexibly positioned

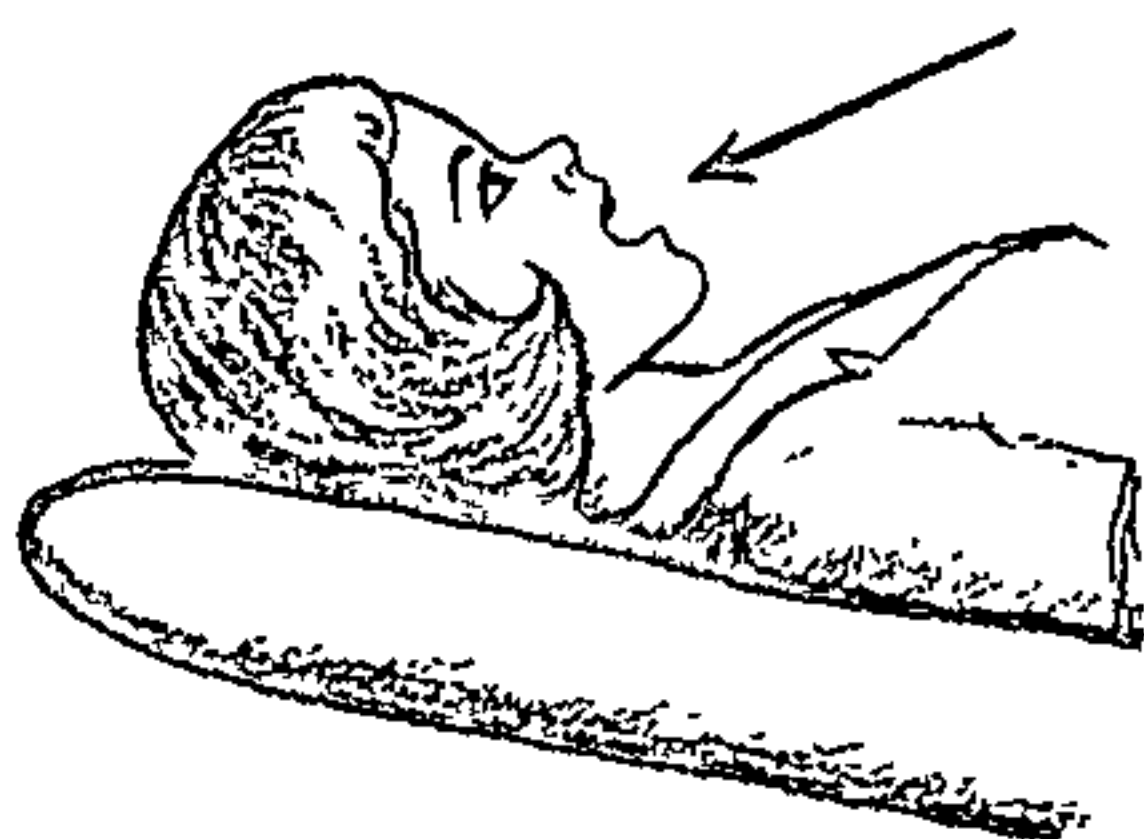


Fig. 5 • Path of illumination of single operatory light for patient in horizontal position, with dentist seated, allows clear view of upper arch only

Figure 10.

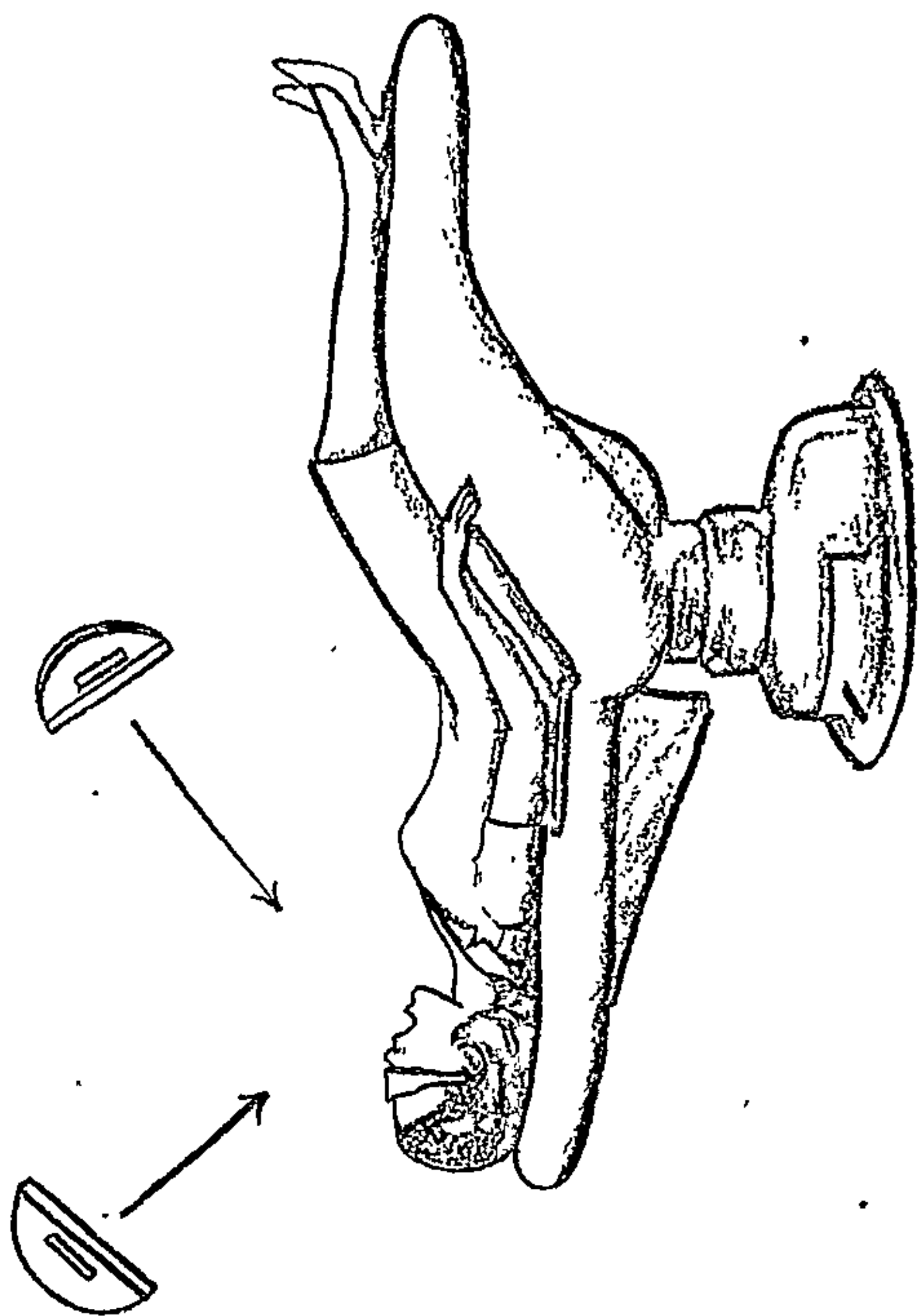


Fig. 8 • Proper placement of dual lighting for complete illumination of both arches when patient is in horizontal operating position and with dentist seated

Figure 11.

The source of light in the Dental Light is the filament. In most fixtures a current of almost 6 amperes at a maximum voltage of 25 volts is delivered to this tungsten filament. Because of this current, the tungsten wire heats up to an absolute temperature, about 2950° Kelvin. At this temperature a visible light is emitted. This light contains varying amounts of all colours from ultraviolet through the visible light spectrum to infra-red. Only a small portion of this light energy is usable for Dental Lighting.

When the tungsten is heated to this temperature, some of the tungsten molecules are literally boiled off the filament. In quartz-line lamps these particles of tungsten mix with a gas inside the lamp. This gas is known as a Halogen and may be either Iodine or Bromine. Iodine gas shows pinkish-purplish colour just after the filament is turned off. Bromine is colourless and this is the reason why some lights are pressurised with bromine. The mixture of tungsten and a halogen and the intense heat inside the quartz walls of the lamp cause a process where the tungsten molecules are returned to the filament. This process lengthens the life of the filament and eliminates the inside blackening of the bulb with tungsten seen on a standard lamp. The light from the source is then taken or collected by the reflector and transformed, amplified, coloured, selected and re-angled. It is at this point that there is variation between various fixtures. All of them end up with about the same result, but do it in different ways.

The light being emitted by this hot filament is received on the reflecting surface of the reflector or mirror. If the mirror was a shape called an ellipsoid or paraboloid, the shape of the projected pattern would be a circle. By varying the radii of the mirror or adding flutes or

individual facets, the shape of the filament is transformed, and amplified to a rectangular pattern of the size used in Dentistry. There are many different ways to do this but for the sake of simplicity, it can be said that the intention is to make every part of the reflector contribute to the total pattern. In this way each part of the reflector becomes a light source and since these light sources are spread over an area, light comes from different directions and tends to soften shadows. There will always be shadow present, especially when an opaque object is placed in the beam and near the object to be illuminated. The filament must be located at the optical focus of the reflector for the pattern to be at its sharpest.

The actual reflecting surface may either be on the front surface of the reflector or on the rear surface. It doesn't make much difference and both methods have advantages and also disadvantages. The coating which reflects is known as a "dichroic" coating. The meaning of this term is "two-colour".

Some of the light energy from the filament is reflected and some of the energy is allowed to go right through the reflector. The coating itself is vacuum deposited on the desired surface and consists of several layers of material totalling just millionths of an inch. Each layer allows certain colours of visible light and other portions of the light energy from the lamp to either be reflected or transmitted through. By proper selection of this coating, the reflected colour and hence the colour of the pattern can be controlled. The desired colour is another entire subject on which numerous books have been written and still there is no definite answer. Basically

the dental light should produce a pattern which appears white and allows colour selection to be determined. Since all dental lights on the market today use basically the same dichroic method, there is not a wide difference in the overall frequency spectrum; however, there is a wide difference in appearance because some lights use an apparent colour temperature which is bluer than others. Skin tones do not appear as natural with a bluer light as they do with a lens which has less blue. This difference is the only difference in the meaning of a light rated at 3900° K, and one at 4500° K, and has a great deal of personal preference associated with it.

All the rest of the unwanted energy produced by the lamp is allowed to be transmitted through the reflector out into the room. It is that unwanted light that is seen when looking into the rear of dichroic dental reflectors. It really doesn't make any difference what this colour is, if the pattern has the correct colour since the transmitted colour is the unwanted colour. A large part of this unwanted energy is the red light and infrared heat. Because this infrared is allowed to pass through the reflector, the reflected light or pattern light has the amount of heat greatly reduced.

If the dichroic coating is applied to the front surface of the glass, less light is lost because the particles of light do not have to go through the glass, be reflected and go through the glass again. Each time the light goes through the glass, the glass absorbs some of the energy and the light is reduced. A front surface coating does have the disadvantage that it is more subject to being damaged by abrasion while cleaning the reflectors. The coating is relatively hard and durable, but it can be scratched, unless soft cloths are used.

If a rear surface coating is used and is providing

adequate light, there is no problem involved in the loss of light twice through the glass. In addition, the coating itself is protected by the glass, whatever rear coating is used. Caution must also be exercised not to damage the protective coating. No matter which surface has been coated, the rear of the reflector should be treated to reduce or scatter the light seen from the rear.

The reflectors are designed to produce the best pattern from 30" to 40" from the reflector. Some dentists may use them somewhat closer, but this normally doesn't present any problem. Dentists operating with their patients in the fully-reclining position or even semi-reclining position find that they are placing the light directly over the patient. Should anything happen to the lamp to cause the envelope to fracture, the glass particles would fall directly on the patient. It is for this reason that it seems to be good engineering practice to include as an important part of the fixture, a plastic light shield capable of retaining glass particles. (23)

Lighting can have a significant effect both on postural and visual fatigue. Shadows and uneven illumination can aggravate already undesirable postures, for where the eye leads the head and trunk will follow, while differing levels of background illumination cause fatigue. There is little published data on the optimum intensity of operating lamps. The American Illuminating Engineers Society recommend an intensity of 11,000 lux and undoubtedly this level or something near it is desirable. With these relatively high levels of oral cavity illumination, the general surgery illumination must also reach a high level to prevent visual fatigue as the dental operator alternates his attention between his task and his hand equipment, and it is generally recommended that the ratio of task-to-background illumination

should not exceed 4:1. The average background illumination in many surgeries is such that the ratio is frequently very much higher than this and this point should, therefore, be very carefully borne in mind.

To enable matching and mixing dental materials, the colour quality of the light source is another important factor. This is usually defined as the colour temperature of the source. Those sources which are rich in red radiation have a low colour temperature, $1,000^{\circ}\text{K.}$, and those at the higher end of the scale are pre-dominantly blue at around $12,000^{\circ}\text{K.}$ There appears, however, to be no consistency in the quoted value of the optimum colour temperature and lamps with colour temperatures varying between $3,800^{\circ}\text{K.}$ and $6,500^{\circ}\text{K.}$ are all on the market as appropriate to enable accurate colour matching and mixing. This point is obviously important, and it is suggested that the dentist should examine for himself matches which he thinks are suitable in the light he is proposing and then see how they look when they are exposed to both bright daylight and to direct sunlight.

In the case of the operating lamp the beam profile of the source of illumination is one of its most important characteristics. A parallel rectangular beam is required for intra-oral work. A different beam, while wasting light, can be objectionable by scattering glare into the patient's eyes. The lamp too must be easy to adjust both vertically and in its angle. If the chair is adjusted so that the patient's head is in the most suitable position, both with regard to elevation and angle, then the light too, must be simple to adjust so that the mouth is suitably illuminated. Whatever form of light is chosen, the amount of heat generated by the lamps should be carefully considered in the interests of the comfort of both operator and patient.

(22)

DENTAL LIGHTING

BRAND	TYPE GLOBE	TRANS AT VOLTAGE	GLOBE AT VOLTAGE	HRS. WORKED	FOCAL DISTANCE	LUMENS PER SQ/FT	TRANS SETTING	COLOUR TEMP. KELVIN	TEMP RISE 15 HRS	OPERATING FIELD	DEFINITION OF BEAM	S.E.C APPROVAL	PRIMARY VOLTAGE	ENVELOPE TEMP
1 Sirolux Siemens	Q1	12 10.7	12 (H) 10.6 (L)	4 Hrs.	36"	1000 600	1 2	3800	1°F	9" x 4"	Furred Edges	Yes	240	H. 330°C L. 310°C
2 Sirolux Siemens	Q1	12 10.7	12 10.6	4 Hrs.	36"	1400 1000	1 2	3800	1°F	9" x 4"	Furred Edges	Yes	240	H. 330°C L. 310°C
Light Fantastic Pelton Crane	Q1	26 24.5 22.5	25.5 (H) 24 22 (L)	4 Hrs.	36"	2300 2000 1400	1 2 3	4000	13°F	14" x 3"	Fair Cut Off	No	240	H. 490°C M. 440°C L. 400°C
O & V Sunlight	Q1	18.25 15.8	18.0 (H) 15.5 (L)	4 Hrs.	36"	1600 1000	1 2	3800	5°F	9" x 5"	Oval Poor	No	240	H. 330°C L. 310°C
Ash A.D- Inter- national	Q1 Sealed Beam	14.5 13.0	14.0 (H) 12.6 (L)	4 Hrs.	36"	2400 1600	1 2	4500	11°F	12" x 3"	Excellent	No	240	Sealed Beam
Ritter Starlite	Q1	26 21.5 18.0	25.7 (H) 21.0 17.5 (L)	4 Hrs.	36"	2500 V 1000	V	4500	14°F	9" x 5"	Good	No	110	H. 500°C M. 440°C L. 370°C

Table 4.

ARMS OF DENTAL LIGHTS							
.....ADJUSTABLE.....							
TYPE	DEGREE OF TILT	VERTICAL MOVEMENT OF HAND	RADIUS OF YOKE	RADIUS OF HEAD AND OF COLUMN	DISTANCE HEAD FROM GROUND	STABILITY LACK OF DRIFT OR VIBRATION	EASE OF MOVEMENT
Sirolux Siemens	285°	25"	300°	60½"	49½"	Good	V.G.
Pelton Crane Light	270°	24"	240°	52"	47"	V.G	V.G.
Ritter Starlite	175°	37"	180°	48"	26"	V.G.	V.G.
Sunlight D & V	210°	26"	180°	51"	52"	G.	G.
Ash	180°	22"	180°	53"	57"	V G.	G.
Old Type Sterling	90°	24"	200°	51"	53"	Poor	Poor

Table 5.

CAPITAL COST				
TYPE	CAPITAL COST PER ITEM	BULB REPLACEMENT	BULB RATED LIFE	TIME CHANGED
Siemens Sirolux	\$354.00	\$5.10	On Highest Setting 2000	11 Months Nil
Light Fantastic Pelton Crane	\$252.00	\$20.00	4000	11 Months Nil
Ritter Starlite	\$258.00		2000	4 Months Nil
O & V Sunlight	\$242.00	\$5.10	2000	24 Months 1
Ash	\$312.00	\$50.00	L. 15,000 No Time Given H.	11 Months Nil

Table 6.

DENTAL OPERATING LIGHTS - FIBRE OPTICS

One of the problems of conservative dentistry has been to provide good illumination, not only in the mouth as a whole, but also in the particular region of a preparation. There is now available, a means of conducting light along a flexible tube. This owes its origin to a patent taken out in 1927 by John Logie Baird. He employed the phenomenon of internal reflection at an interface between media of different refractive indices, to conduct light down fine glass rods. The development of this principle of light transfer was given new impetus by the technique of sheathing a glass fibre of one refractive index, thus giving internal reflection at an interface, protected from both scratches and dust particles.

A powerful, cold and electrically safe source of light can now be brought within the mouth. A number of companies are producing fibre optic equipment and it is envisaged that future dental units will contain a light source for this type of illumination. There are a variety of ways in which this lighting may be incorporated within dental instruments including handpieces. These include, aspirator tubes, rubber-dam clamps, mouth props and head lamps. (24) (Figure 12)

A comparison of fibre-optic lights is shown in Table 7 (25)

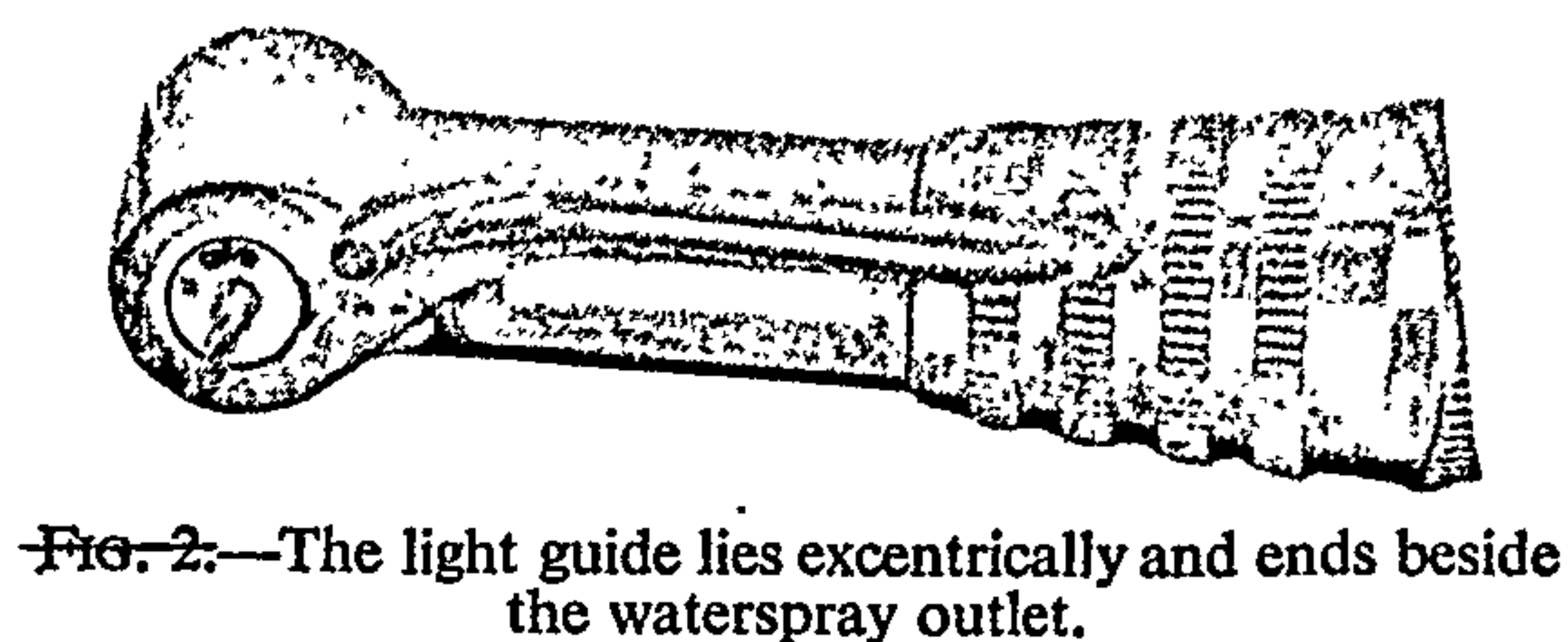
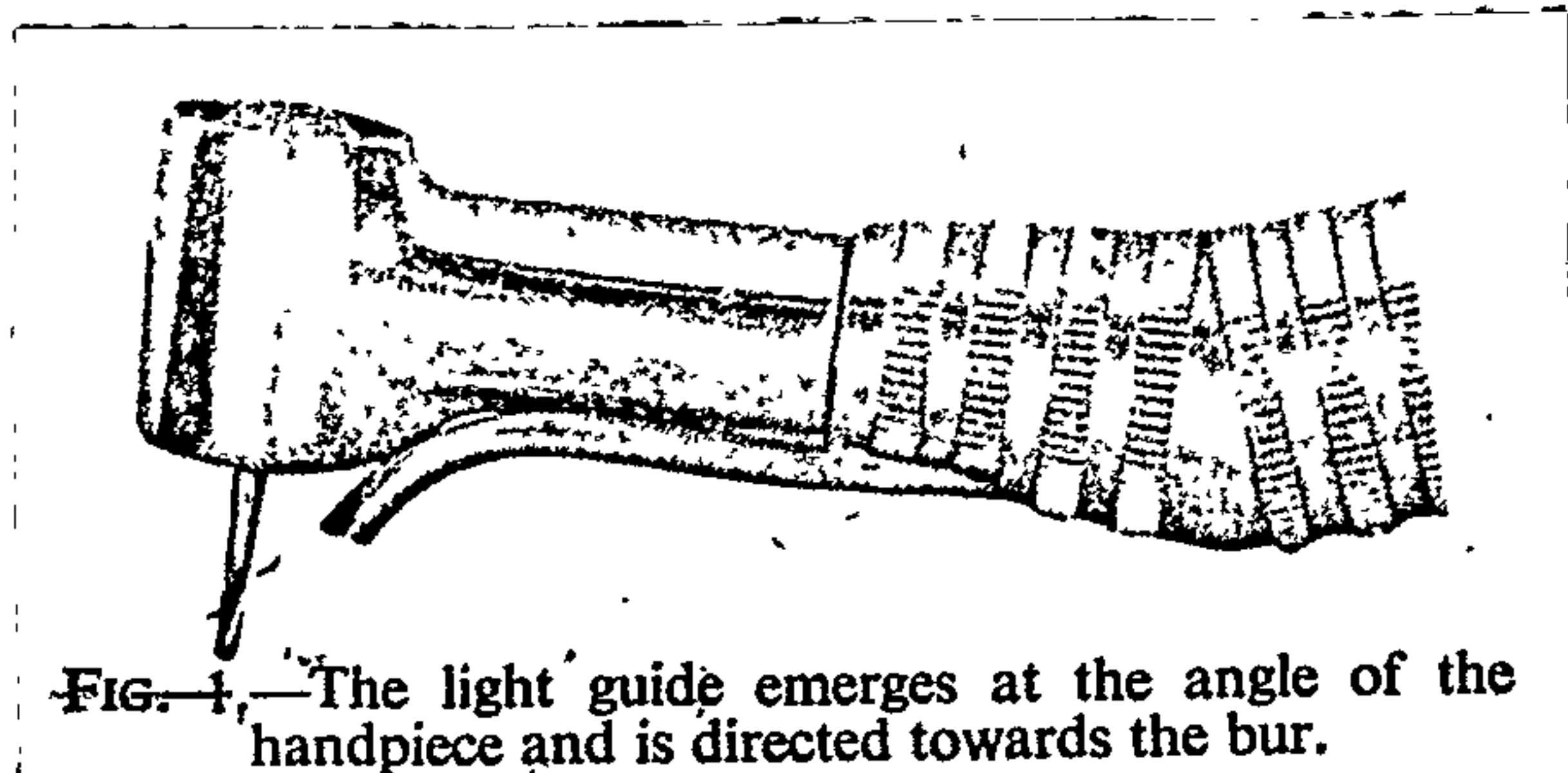


Figure 12.

Table 1. Comparison of Fiber Optic Light Systems

TRADE NAME OF FIBER OPTIC LIGHT SYSTEM	BIOLITE	INTRA-ORAL ILLUMINATOR	ORALITE	ORALUMINATOR	VICONEX
Mfg. Distributor	Dentsply Inst. Co.	Lactona	Young Dental Mfg. Co.	Midwest- American	Vicon Products Corp.
Unit Dimensions	9" x 7 1/2" x 4 1/4"	7 1/4" high 5 1/8" wide at base	5 3/4" x 4 1/2" x 5"	11" x 5 1/2" x 6 1/2"	5 1/2" x 5 3/4" x 10C
Weight of Unit	9 pounds	5 pounds	3 1/2 pounds	9 1/2 pounds	6 1/2 pounds
Type of Lamp	Halogen	Halogen	Halogen	Halogen (two lamps)	Halogen
Reflector	Integral	Integral	Part of Unit	Integral	Integral
Bundle Length	6 feet	6 feet	6 feet	6, 12, or 18 feet	6 or 9 feet
Light Output in Footcandles	0-1500	1,000-1,175-1,350 1,500	up to 1,000	0 - 1,700	up to 1,000
Mounting	Table	Table or Wall	Table	Table	Table or Wall
Noise Level of Fan	Quiet	Acceptable	Acceptable	Very Quiet	Fairly Quiet
Access to Bulb	Base of Unit hinged door	Top of Unit lock screw ejection lever	Top of Unit hinged lid	Back of Unit piano hinged	Side of Unit hinged door
Sterilization of Bundle	Do Not Autoclave (Cold Sterilization)	Do Not Autoclave	May Be Autoclaved	Do Not Autoclave Clean with Liquid Detergent	Do Not Autoclave
Sterilization of Accessories	Do Not Autoclave (Cold Sterilization)	May Be Autoclaved	May Be Autoclaved	May Be Autoclaved	May Be Autoclaved
Number of Ports Available	4	2	1	2	1 or 2
Intensity Control	Rheostat 2-10	4-Position Switch	3-Position Switch	Rheostat Full Range	Rheostat Full Range
Control Location	Remote	Front Panel	Rear Panel	Front Panel	Front Panel
Available Accessories	Handpiece Oral Evacuator Mirror Probe Cavitron	Handpiece Mirror Probe	Handpiece Mirror Probe	Handpiece Mirror 3 Probes	Handpiece Mirror Probe Evacuator Clip Finger Ring Light Retractor

Table 7.

EVACUATION SYSTEMS

Most of us are familiar with the physical principles of static air, but once air is in motion, a completely different set of principles apply. It exhibits many of the properties of a liquid. In the physics and principles of motion, liquid and air are both classified as fluids. In dealing with the flow of air when change in pressure is low, even gases or air may be considered as incompressible. It must be remembered that in relation to a water system, where there is a tremendous head of power driving the water through the pipes, in a vacuum system, because it is necessarily a very low vacuum system, there is relatively no head of power. Because there is little power driving the air through the system, any slight irregularities in the set up of a system, such as inadequate nozzle size, poorly designed valves that are too small or irregular, or long and tortuous lines, become major problems. (26)

With the use of the washed field technique in conservative dentistry, and the increasing trend to low-line equipment, it has become obvious, that a high volume suction unit is an integral part of dental surgery equipment. Although many types of mobile suction units are used in dentistry, and an increasing number of pipeline systems are being installed, the functional characterisations of these have been almost entirely determined upon an empirical basis. It is therefore desirable to lay down more scientifically determined criteria for effective performance. (27)

VACUUM DATA AND SYSTEMS COMPARISON

Vacuum has three basic measurements: (1) Pressure, (2) Air Flow, and (3) Resistance.

(1) Pressure, measured in inches of water lift or inches of mercury. Inches of water is a standard for low vacuum. Inches of mercury is standard for higher vacuum. 13" vacuum water lift equals approximately 1" mercury.

Pressure is needed to lift or pull fluids through vacuum hoses and plumbing as well as to overcome resistance to air flow caused by plumbing and hoses.

Vacuum pressure, or inches of mercury (HG), must be high enough to pull the liquids through the plumbing and hoses or the vacuum system will bog down and air flow will stop. However, if inches of mercury pressure is excessively high the vacuum nozzle will grab the tender tissue in the patient's mouth and cause discomfort or even injury.

Vacuum pressures of over 8" HG may be uncomfortable to the patient. On the other hand, vacuum pressure of under 4" HG are often not adequate to move fluids or solids through the HVE hose and plumbing. Most blowers are under 4" HG. A happy medium is a setting of from 5" - 6" HG.

(2) In a dental vacuum system air flow is generally measured in cubic feet per minute. In dentistry, an HVE vacuum system requires large volumes of air to flow through the system, or a large number of cubic feet per minute. An ideal dental vacuum system must have a correct balance of both vacuum pressure or inches of mercury and air flow or C.F.M.

The principle function of the HVE system is to vacuum clean the mouth so the dentist's field of vision is clear while cutting with a high speed instrument. The HVE nozzle also must not restrict the dentist's vision or hamper the movement of his handpiece. To meet this requirement, the

air flow into the HVE nozzle must be high, or a minimum of 5 - 6 c.f.m. This high rate of air flow enables the vacuum nozzle to entrain or drag in fluids or sprays without obstructing the dentist's vision or movement of his cutting instrument.

(3) Resistance is caused by plumbing and vacuum hoses. This is controlled by installing vacuum plumbing of an adequate size, using as few tees and ellis as possible, and avoiding dips or sags in plumbing, or installing vacuum plumbing so liquids must be pulled up over high obstructions, etc.

Example: If pressure in HVE plumbing is adequate and air flow is low, undersize plumbing could cause inadequate air flow.

The second most common use for a central evacuation system is surgical vacuum. Here the requirements differ from the HVE central system as follows:

1. Higher vacuum pressure is desirable ranging from 12" HG. Most generally, small vacuum tips are used and high air flow is not essential. In other words, the dentist needs power (pressure), not air flow. Blower types won't do this.
2. Air flow ranging from $\frac{1}{2}$ to 3 c.f.m. is most generally adequate, as the tip may be immersed in the fluids to be evacuated. Also, the volume of fluids to be removed from the mouth is relatively small compared to the HVE requirements.

TYPES OF VACUUM SYSTEMS

DRY SYSTEM (Figure 13)

Examples: Vacudent
Ritter, as used in Modulaire.

So-called dry plumbing system has a fluids and solids collector in each operator. Each operator has a drain trap into the building sewer system.

The vacuum plumbing between the operatory and the vacuum power source, which is most often a vacuum cleaner motor or blower which liquids will damage, does not carry any liquids or solids.

Advantages: (Dry System)

- a. Plumbing from vacuum motor to operatories may be installed in ceilings above the operatories, if local codes permit.
- b. Manufacturers claim plumbing between operatories and vacuum motor sanitary because they carry no liquids or solids. However, they still carry moist bacteria-laden air and could become odorous. Chicago plumbing test lab still considers these pipes wet and maintain they should be installed so they may be flushed with cleaning agents and germicides.
- c. Dry vacuum piping between the vacuum motor and the operatory can be installed outside the building. In freezing temperatures it will not clog from freezing because it carries no fluids.

Blowers are usually very noisy and short-lived.

Exception: U.S. General (bulky). DriClave De Luxe (bulky) low noise, still short-lived.

Disadvantages: (Dry System)

- a. Installations are sometimes more expensive because a drain must be provided in each operatory.
- b. Collection traps are prone to service problems such as:
 - 1. Drain check valve prone to stick open or shut. This causes either vacuum leak into the drain system or the vacuum system to shut off until the valve is repaired.
 - 2. Float valve malfunction causes fluids to be drawn into dry plumbing which may damage vacuum motor.
 - 3. Unexpected vacuum shut-off when sump is full of fluids. The vacuum motor must be shut off before the fluids will drain from the sumps on most systems.

- c. Dry system has limited fluid handling capacity and will not handle sufficient fluids when a vacuum cuspidor or hydrocolloid accessory is installed on them. Capacity of collectors runs from 2/3 quart to 1-1/2 quarts liquid. Vacuum hoses cannot be flushed with large quantities of water unless they are taken off the control. Vacuum motors may overheat if hoses in operatories are shut off.

SEMI-WET SYSTEM (Figure 14)

Examples: Pelton Percheron system
Central-Vac system
Dri-Clave system
U.S. General Vacuum system (blower)

This type of plumbing system may or may not have a solids collector in each operatory.

The fluids and/or solids are carried from the operatories to a central sump or holding container. A sewer drain is provided at the sump. The sump drains each time the vacuum motor is turned off.

The plumbing between the sump and the vacuum motor carries no liquids or solids.

Advantages: (Semi-Wet System)

- a. Plumbing between vacuum motor and sump may be installed in the ceilings above operatories (if codes permit).
- b. Only one sewer connection is required; could be less costly to install than dry system.
- c. Will handle more fluids between motor shut downs than dry system if there are not several operatories connected to the sump.
- d. Dry portion of vacuum plumbing may be installed outside the building. In freezing weather pipes will not clog with ice because the pipes do not carry liquids.

Disadvantages: (Semi-Wet System)

- a. Sump subject to service problems.
- b. Drain check valve sticks open or closed, causing vacuum

- loss or vacuum to shut off until valve is repaired.
- c. Vacuum shut off float malfunctions may cause fluids to enter dry section of vacuum plumbing. Might cause vacuum motor failure.
 - d. Vacuum float valve sticks, causing vacuum to shut off until float is repaired.
 - e. Systems with no solids collectors in operatories may have solids clog lines between the operatories and sump.
 - f. Unless the blower exhaust is vented outside the building, bacteria-laden air and unpleasant odors may be circulated inside the dental office.
 - g. The large volume of air being circulated over the debris in the sump tank picks up large quantities of bacteria and odors.
 - h. Motors may overheat if vacuum hoses in operatories are shut off.
 - i. Holding sump may collect odors unless cleaned frequently. The large volumes of air constantly dry the debris-laden liquids and tend to make the sumps difficult to clean unless the system is frequently flushed with water.

WET SYSTEM (Figure 15)

Examples: Ritter VacuumAire system
 Coastal Dynamics Dyna-Vac
 U.S. General Hi-Vac system

This type of system may or may not have a solids collector in each operatory.

All fluids and solids, if no solids collector is used in the operatory, are drawn directly from the operatory to the vacuum pump. The pump has a solids collector.

The liquids are drawn through the pump and expelled into a drain.

Advantages: (Wet System)

- a. In a water ring pump such as VacuumAire, up to 99% of the bacteria and viruses are scrubbed from the exhaust air and deposited in the discharge water, which is washed down the

drain.

- b. A water ring pump is constantly cleaning itself internally with fresh water from the city water supply. All liquids from the operatory are diluted with fresh water before then draining into the sewer.
- c. Water ring pumps are generally quieter than blowers used with dry or semi-wet systems.
- d. No holding sumps are necessary to collect the fluids.
- e. System has no liquid collecting sumps to clean or malfunction.
- f. Plumbing requires less space in building because there is no liquid collection sump.
- g. Plumbing system is less prone to leaks or problems because no sump is needed with its drain checks valve and vacuum shut-off float.
- h. Large amounts of water can be drawn through the plumbing pipes to keep them clean. VacuumAire system can flush lines with up to two gallons of water per minute.
- i. If plumbing codes permit, the exhaust, including all bacteria-laden air in liquids, can be flushed down the sewer.
- j. Liquids and fine solids ordinarily encountered in a dental office will not injure the pump.
- k. All vacuum hoses in operatories may be shut off when not needed. Air drawn through the vacuum plumbing does not cool the motor.

Disadvantages: (Wet System)

- a. If solids collectors are not installed in each operatory, solids can clog plumbing, unless plumbing is flushed very often.
- b. This system requires a water-sealed pump. Pump consumes $\frac{1}{2}$ gallon water per minute. However, if the dental office is designed to fully utilize the vacuum

system, total water consumption can be less than in a dental office without a central vacuum system.

AIR-VENTURI VACUUM SYSTEM (Figure 16)

Usually, a relatively small package that hangs on the dental unit.

Principle: Air passes through a venturi orifice and creates a vacuum. Same principle as a water-powered saliva ejector venturi, except higher vacuum air flow around 5 c.f.m. is available at the vacuum nozzle.

Advantages: (Air-Venturi System)

Relatively simple to install; requires no large vacuum plumbing system. Compact; requires little space in the operatory.

Disadvantages: (Air-Venturi System)

- a. Requires large air compressor to produce enough air for adequate vacuum air flow.
- b. Usually quite noisy in operatory.
- c. Usually does not produce as much vacuum air flow as conventional vacuum system.
- d. Must have drain in each operatory. (28)

For motor specifications see Table 8

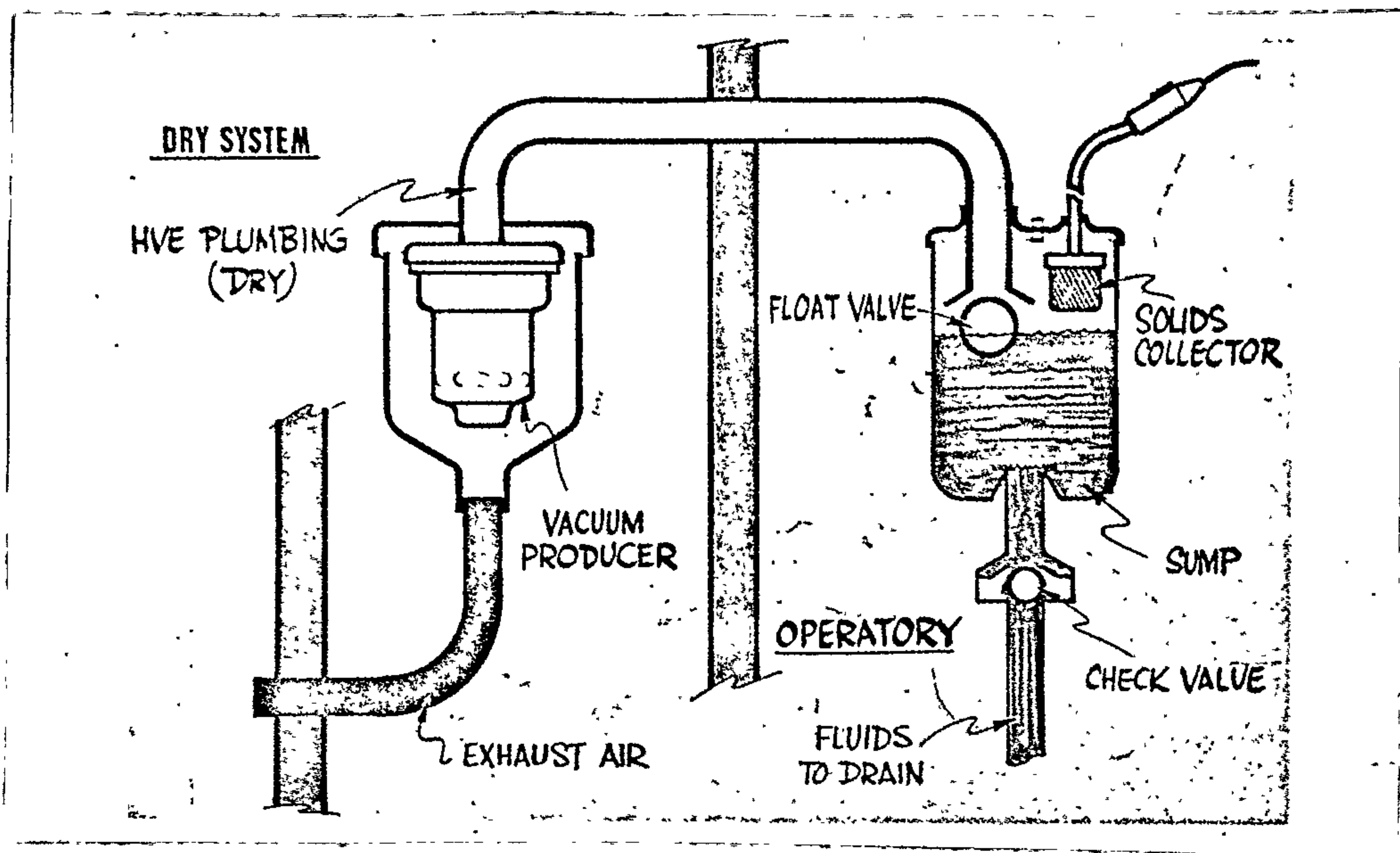


Figure 13.

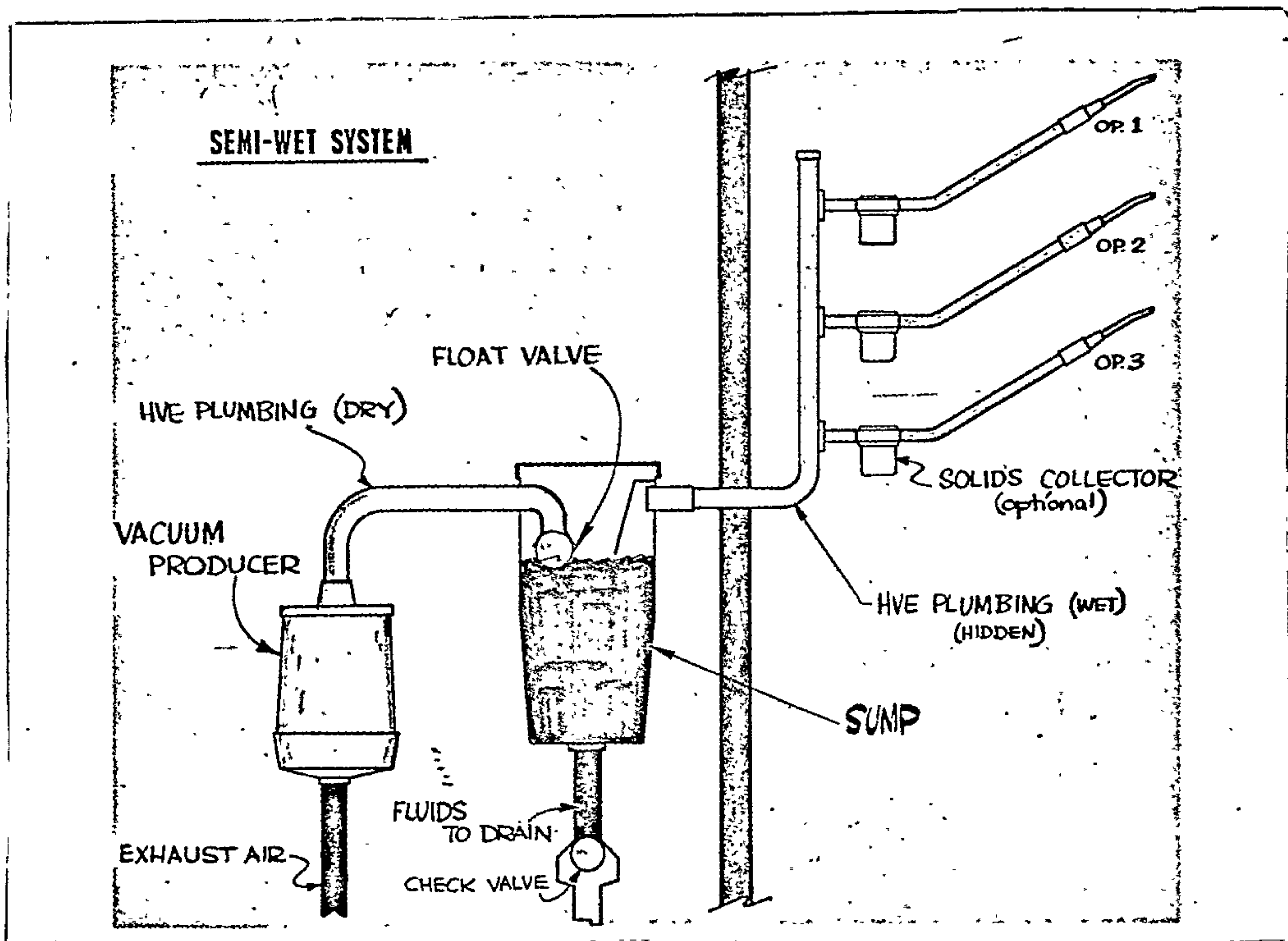


Figure 14.

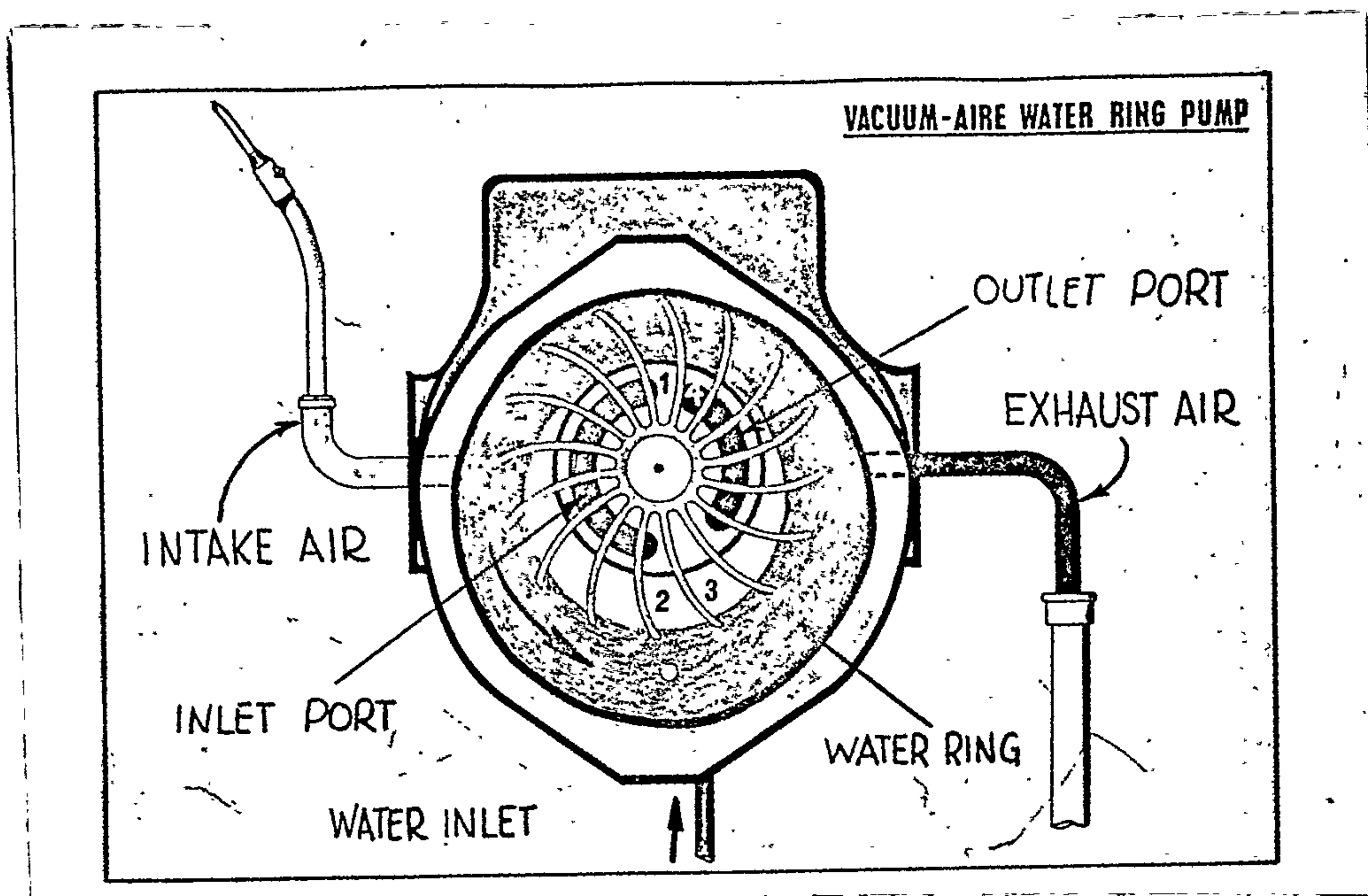


Figure 15.

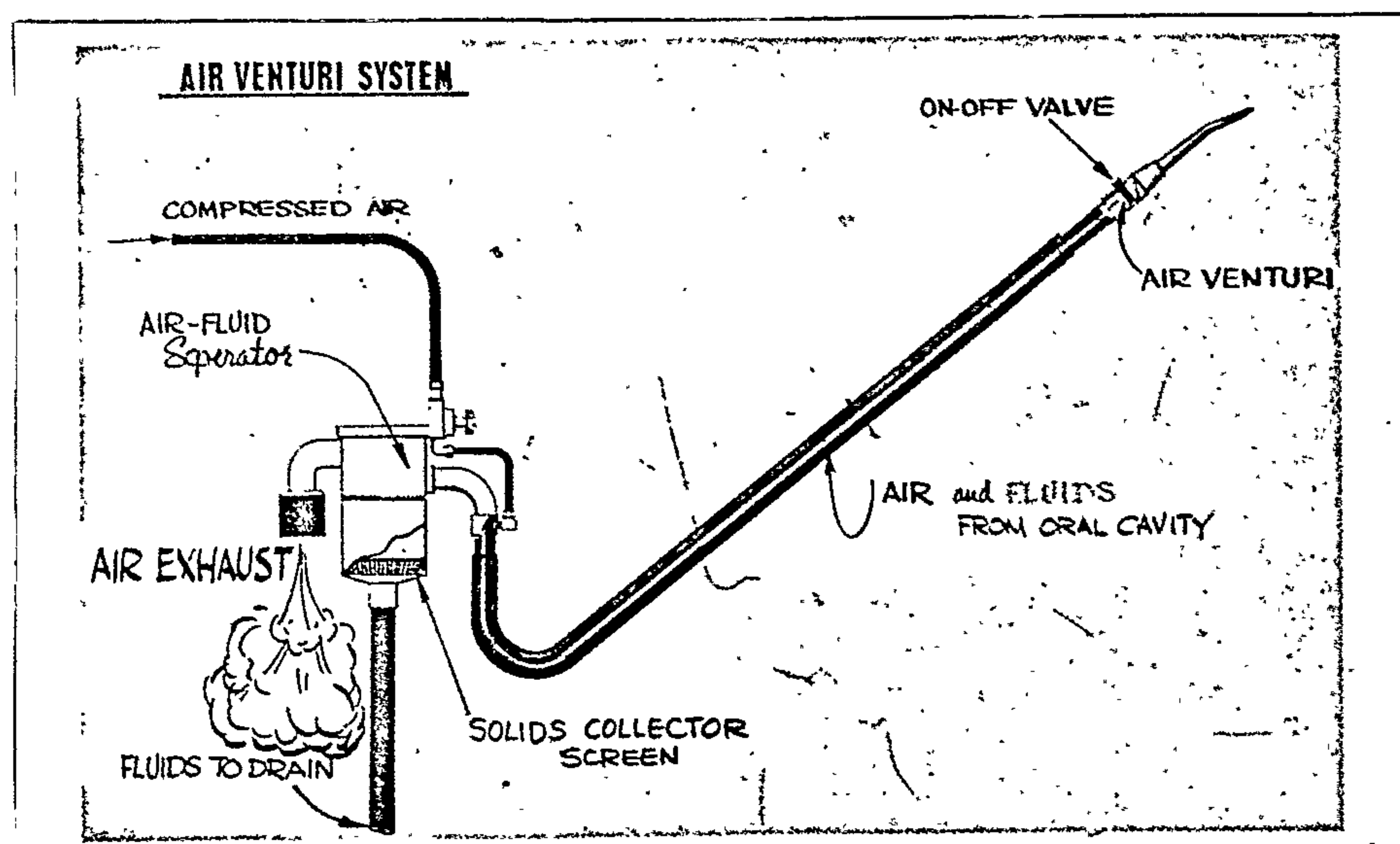


Figure 16.

Model #	Type
CV-101-H	Hi-V.
CV-102-H	Hi-V.
CD-202	Turb.
CD-203	Turb.
CD-205	Turb.
CD-207-5	Turb.
CD-210	Turb.

*Water injected per
 All motors are rated
 high heat lubricant

Table 8.

ULTRASONIC INSTRUMENTS

Ultrasonic applications are based on physical vibrations of particles of matter - similar to sound waves - at frequencies above the range of human hearing. These frequencies range from 20,000 Hz (Hertz-cycles per second) to many million Hz. A vast range of ultrasonic instrumentation is currently available, each application uses a specific frequency, or band of frequencies, and an amount of power output best suited for that application. (31)

Most ultrasonic equipment contains two basic units - an ultrasonic generator to produce high-frequency electrical current and a transducer, which converts the electrical energy it receives from the generator to mechanical energy (vibrations). The dental application utilizes materials that are ferromagnetic and magnetostrictive. Ferromagnetic metals (steel, iron, cobalt nickel, and a number of alloys) are capable of being magnetized. Magnetostriction refers to the change in shape resulting from magnetization because of the physical realignments of crystal domains within the material. The change in shape is small; in nickel, one of the most active magnetostrictive materials, the change is thirty parts per million. At peak vibration, motion of about one part per thousand may be obtained.

Ultrasonic electrical generators are called oscillators and may generate an electrical frequency anywhere from 16,000 to many million Hz. The ultrasonic oscillator may consist of either a vacuum-tube or transistor (solid-state) circuit. The oscillators are operated by connection to the 115 volt 60 cycle (Hz) power source. The high-frequency electrical current produced in the oscillator circuit passes through the coil of wire around the transducer and causes the transducer material to vibrate in step with current alternations. (Figures 17,18) Table 9 compares the various types of ultrasonic units available.

ULTRASONIC DENTAL UNITS, CHARACTERISTICS

	<i>Cavitation Model 660</i>	<i>Ultrason 880</i>	<i>Sonic Scaler</i>
Output freq. of vibration	25 kHz (25,000 cycles/sec)	25 kHz	25 kHz
No. of power settings	3	3	3
Type of circuitry	Vacuum tube	Solid state (transistorized)	Solid state (transistorized)
Fuse protected	Yes	Yes	Yes
Applications	Scaling, root planing, curettage, ultrasonic GVP-GVC, surgery, drug administration, overhang removal	Scaling, root planing, curettage, overhang removal	Scaling, overhang removal
Palpation	Good with power off; fair with power on	Good with power on or off	Good with power on or off
Type of tips	Insert type (combined magnetostrictor/tip)	Screw-in	Screw-in
No. of tips currently available	27	5	3
Water delivery tube	Outside working tip	Within working tip	Within working tip
Sound emitted	High-pitched, low-intensity, audible	Almost inaudible	Almost inaudible
Sterilization	Cold sterilization of insert parts; hot sterilization to 250° F	Cold or hot sterilization of tips	Cold or hot sterilization of tips

Table 9.

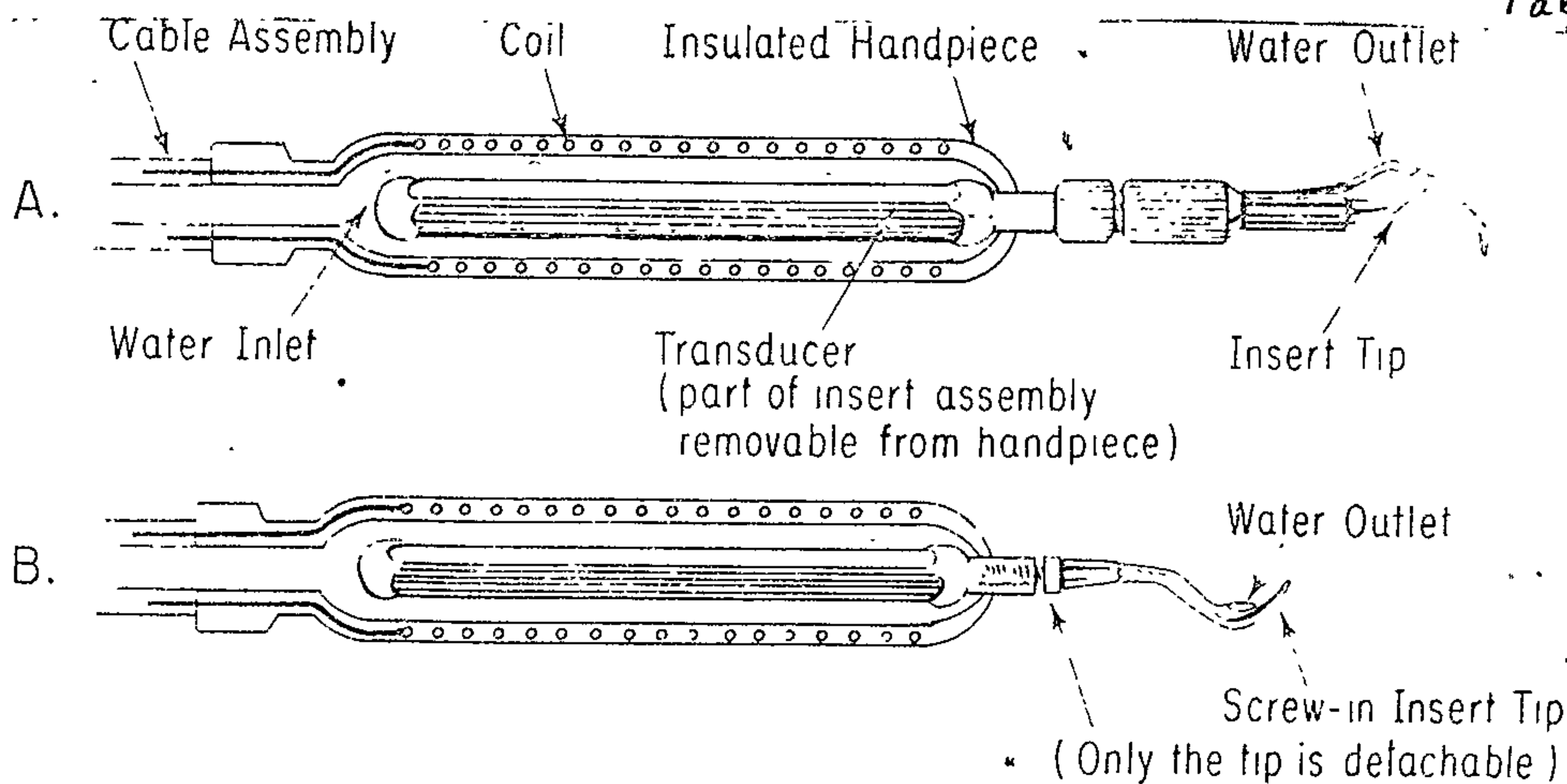


FIGURE 15. Handpiece assemblies, two basic types.

- A. Tip and magnetostrictor form an integral assembly. The selected assembly is inserted in handpiece.
- B. Magnetostrictor remains in handpiece; screw-in tips are used.

Figure 17.

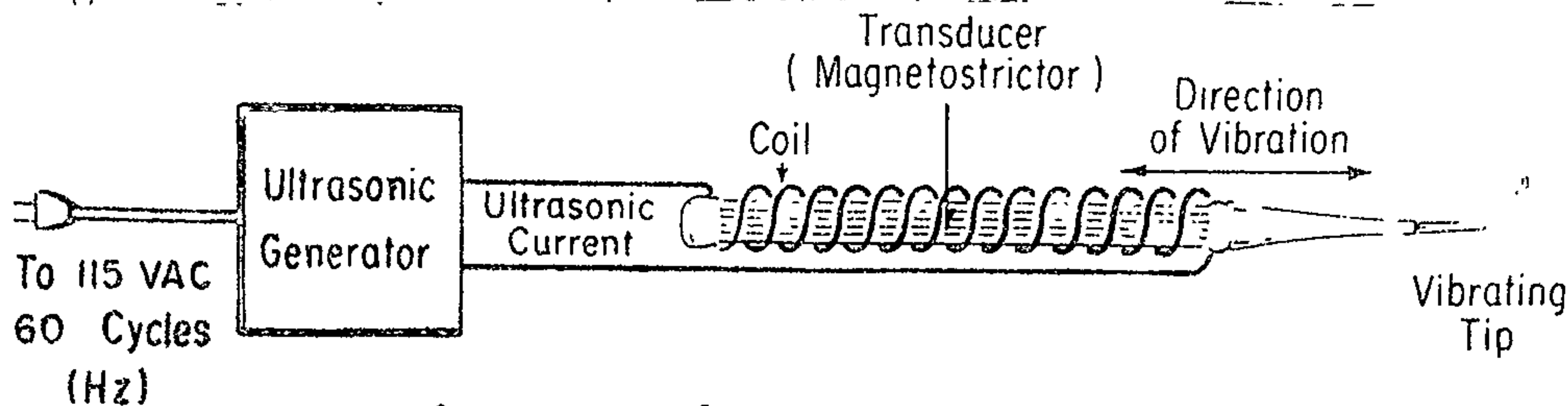


FIGURE 18. Basic periodontal ultrasonic equipment setup.

Figure 18.

COMPRESSORS

Modern dental equipment requires substantial amounts of clean, dry, compressed air. In some instances, the daily volume of air consumed in a dental practice to-day is up as much as fivefold compared to a few years ago. Pressure of 80 pounds is becoming more common. Compressed air is virtually the power plant of to-day's dental surgery.

A compressed air supply basically consists of a means for compressing air, and a means for drying it. The compressor takes air in from its surroundings, raises its pressure, and then stores it in a receiver tank. The dryer cleans and dehumidifies the compressed air. (32) Air operated equipment, particularly the controls such as the air solenoid valves, the dental unit, and the handpiece, will malfunction and deteriorate in the presence of humid compressed air. The dryer by reducing the humidity, provides the needed protection.

Compressors are designated by horsepower, which is the size of the motor driving them, and are rated by the volume (cubic feet of air per minute) they deliver at some specified pressure. Most compressors attain adequate pressures, but they differ in delivered volume. At 75 pounds pressure, a $\frac{3}{4}$ h.p. compressor can deliver about three cubic feet of air per minute, while a $1\frac{1}{2}$ h.p. compressor will deliver about six cubic feet of air per minute, at that pressure. Compressors should not be selected on the basis of pressure alone, or on pump-up time, recovery time or displacement. The proper criteria are horsepower required, and volume delivered at a required pressure.

A dentist will save considerable expense in maintenance if he has moisture-free dry air. His selection should consider not only adequate dry air, but also ease of maintenance, whether it is too noisy for a dental surgery and whether the discharge

of moisture and oil residue is a problem. Compressors that need oil should be easy to check for oil level, and the oil inlet should be accessible.

ELECTROSURGICAL

Electrosurgery is the application of electrically generated heat energy to living tissue to alter or destroy it for therapeutic purposes. (35) Electrosurgical equipment consists of:

1. Spark-gap generator. This was the earliest and simplest electrosurgical instrument. Operating on the principle of condenser discharge across a spark-gap, it produces unrectified current of highly damped waveform similar to that of the single cycle of alternating current.

2. Electronic instruments. (Radioknives)

With the advent of De Forest's vacuum-tube oscillator, or "radio-tube", a new high-frequency current of different waveform was demonstrated. Electronic surgical instruments vary in design and circuit. They range from single power vacuum-tube units built with three or more tubes, transistors, or rectifiers. The electronic instruments have one thing in common - they can all perform electrosection. A considerable variety of electrosurgical equipment is currently available and they form an important adjunct to portable dental equipment.

X - RAYS

In 1923, the Coolidge shockproof dental X-Ray machine was introduced to the dental profession. In present dental X-Ray machines, the filament and high-voltage transformers are located behind the X-Ray tube, which is situated near the front of the X-Ray head, and many modern X-Ray machines employ a distance of 7 inches between the focal spot of the X-Ray tube and the end of the cone. This distance is known as the S S D (source-skin distance).

Richards (36) has introduced a new concept by locating the X-Ray tube behind the transformers, and near the back of the X-Ray head. (Figure 19)

With new design, X-Ray machines have become more compact and are now readily transportable and can be used in portable surgeries. The Rinn Corporation have taken the guesswork out of X-Ray angulation with a series of plate holders which guarantee distortion free radiographs.

There is a steady movement towards full-mouth radiography by the pan-oral technique with a single shot. This does much to reduce radiation hazards to patient and operator. At their present stage of development they are too bulky for consideration as portable equipment. Dark rooms for film processing seem to be on the way out. Day-light loading machines which develop, wash and fix X-Ray plates are now being used and are ideal for a portable surgery. (37)

There are also X-Ray film packs available, containing their own developing and fixing solutions within the pack itself. Vol.2, Plate 52

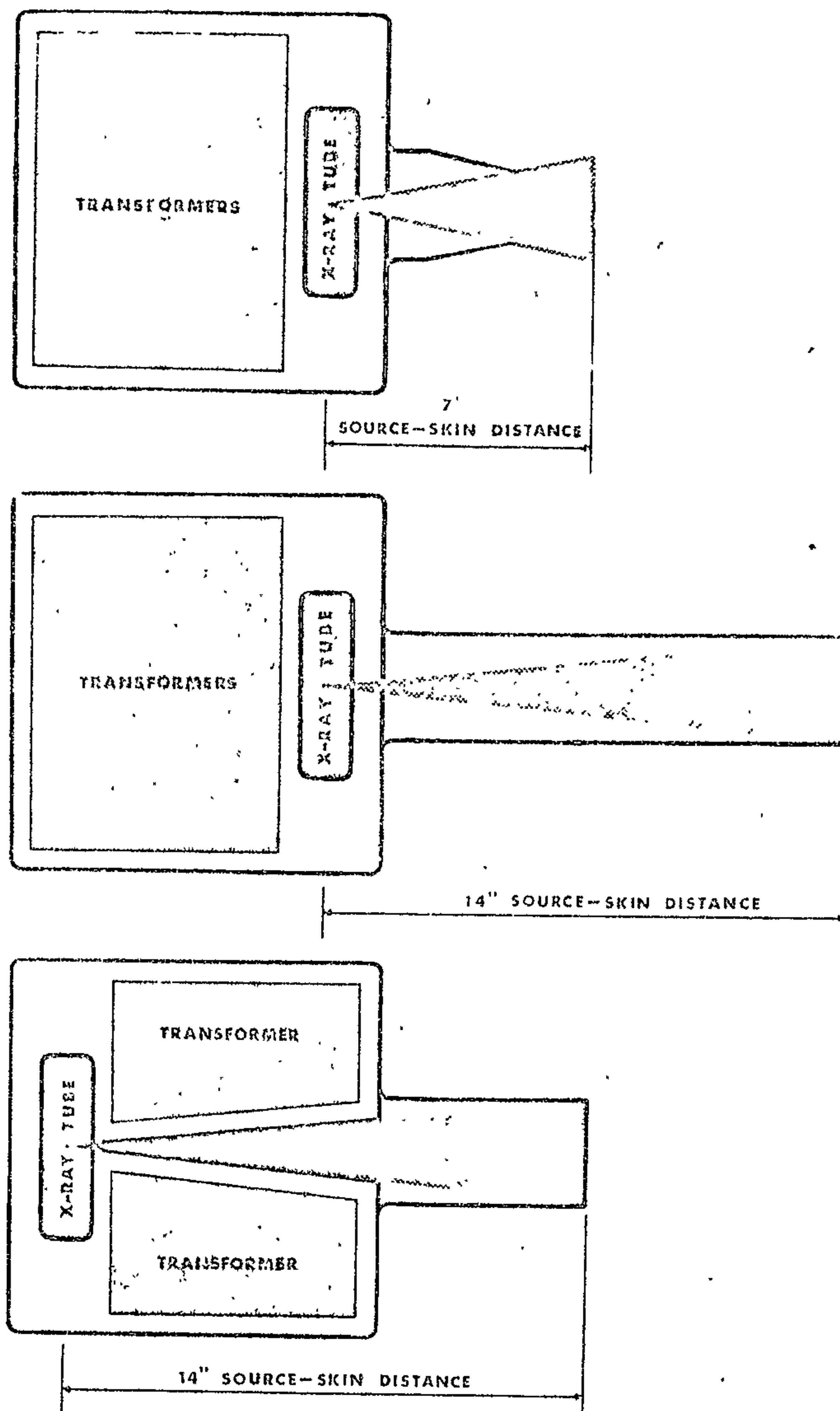


Fig. 19 □ Top: Conventional dental X-ray machine equipped with short pointed cone that provides a SSD of 7 inches. Center: Conventional dental X-ray machine equipped with long open-ended cone that provides a SSD of 14 inches. Bottom: Experimental dental X-ray machine in which X-ray tube is located at back of head, thus providing a SSD of 14 inches, of which half is contained within the head

Figure 19.

HANDPIECES

Dental handpieces and associated equipment such as burs and stones are precision instruments used for cutting, grinding, and polishing procedures at the dental chair as well as in the laboratory. The development of rotary equipment was an evolutionary process up until 1946. The most significant dates, instruments and approximate maximum speeds of rotation are listed. (33) Table 10

DATE	INSTRUMENT	SPEED
1728	Hand driven rotary instruments	300 rpm
1871	Foot driven engine	700 rpm
1874	Electric engine	1,000 rpm
1914	Dental unit	4,000 rpm
1942	Diamond cutting instruments	5,000 rpm
1946	Old units converted to increase speed	10,000 rpm
1947	Tungsten carbide burs	12,000 rpm
1951	Airbrasive	non-rotary
1952	Ultrasonics	non-rotary
1953	Ball bearing handpieces	25,000 rpm
1955	Water driven turbine handpiece	50,000 rpm
1955	Belt driven angle handpiece	180,000 rpm
1957	Air driven turbine angle handpiece with ball bearings	250,000 rpm
1961	Air driven turbine straight handpiece	25,000 rpm
1962	Air driven turbine angle handpiece with air bearings	800,000 rpm

Table 10.

Dental handpieces are classified according to the driving mechanism, they are: gear driven, water driven, belt driven, and gas driven.

i) Gear driven handpieces. One of the oldest and largest group of handpieces is made up of what is known generally as the conventional type.

- a) Straight - handpiece
- b) Contra - angle handpiece
- c) Prophylaxis handpiece.

Rotary power is transferred to the straight handpiece by a belt that runs from an electric engine over a series of pulleys and a three-piece extension cord arm. Rotary cutting instruments are inserted into a chuck at the front of the handpiece. The desired angle handpiece is attached over

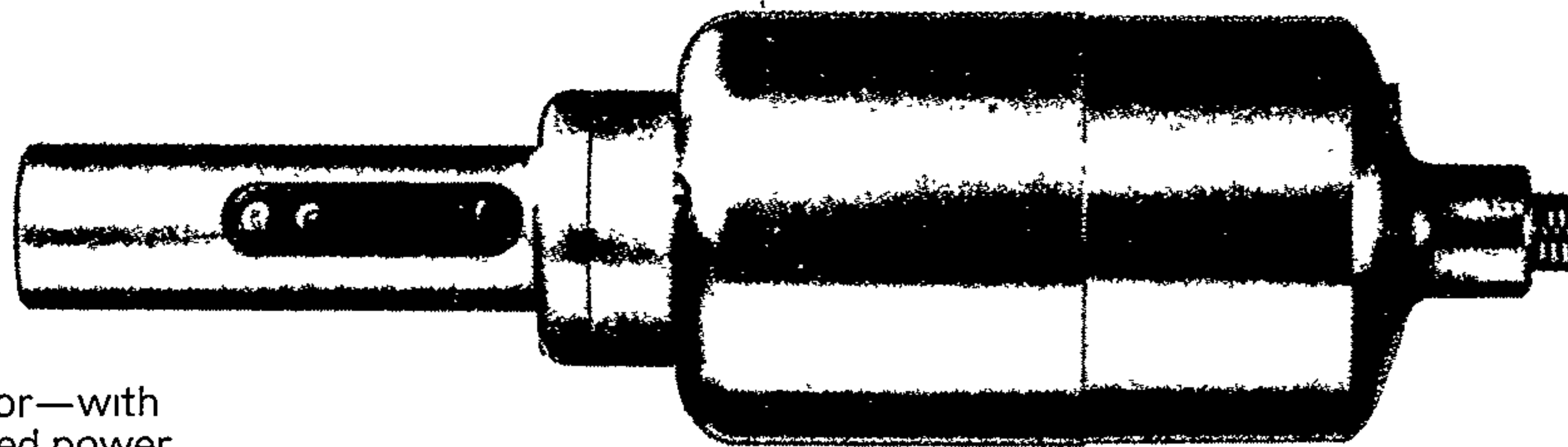
the front end of the straight handpiece for operation. Rotary power is transferred from the straight handpiece by a shaft and gears inside the angle section. Conventional handpieces are designed to operate at speeds under 5,000 r.p.m. Many models now have improved bearing surfaces that allow greatly increased speeds. By the use of several speed-increasing transmissions, it is possible to obtain speeds of 100,000 r.p.m. The most recent addition to the gear driven type of equipment is a handpiece that has an attached miniature electric motor. The unit is light in weight, has high torque, and variable speeds up to 20,000 r.p.m. Being self-contained, it is portable and needs only a source of power. (Figure 20)

ii) Water-driven handpieces. In 1953, a hydraulic driven turbine handpiece was reported to operate at 60,000 r.p.m. Two years later the first commercial model called a "Turbo-Jet" became available. Improved units have both straight and angle handpieces which will operate at speeds up to 100,000 r.p.m. The "Turbo-Jet" is designed as a compact mobile unit requiring no plumbing or air compressors, only a source of electricity is needed to operate the unit. The soundproof cabinet contains a motor, water pump, water reservoir, and necessary plumbing for circulating the water. The unit is portable and can be moved from one surgery to another, or to a hospital operating room.

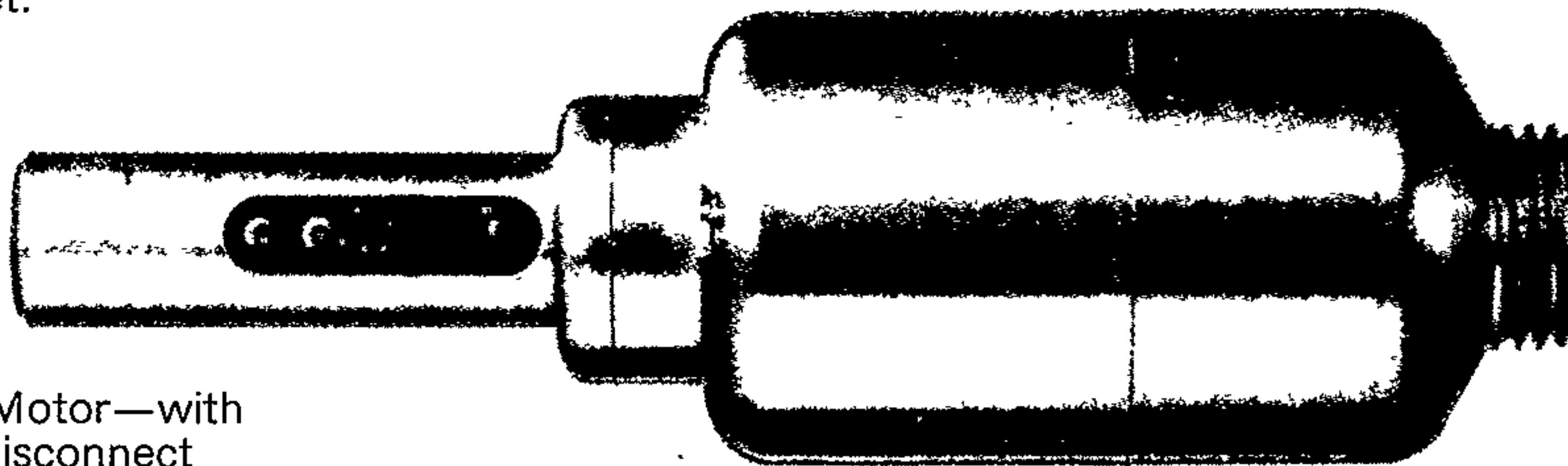
iii) Belt-driven handpieces. A belt-driven handpiece called the Page-Chayes became available in 1955 and was the first angle handpiece to operate successfully at speeds above 100,000 r.p.m. All gears are eliminated by having a small belt run inside the handpiece sheath over ball-bearing pulleys in the angle section. The angle handpiece has a smooth transition of speeds between 1,500 and 180,000 r.p.m. Belt driven handpieces are relatively free of maintenance problems because the bearings have factory-sealed lubrication.

The Electro-Torque A Motor is small (1-3/4" long by 1" diameter) and lightweight (less than 3 ounces). It delivers 3½ inch-ounces of torque (nearly twice that needed for routine dental work) and operates at speeds from 0 to 20,000 rpm. The A/QD Motor has a quick disconnect cord set for strain relief cable plus water and air spray.

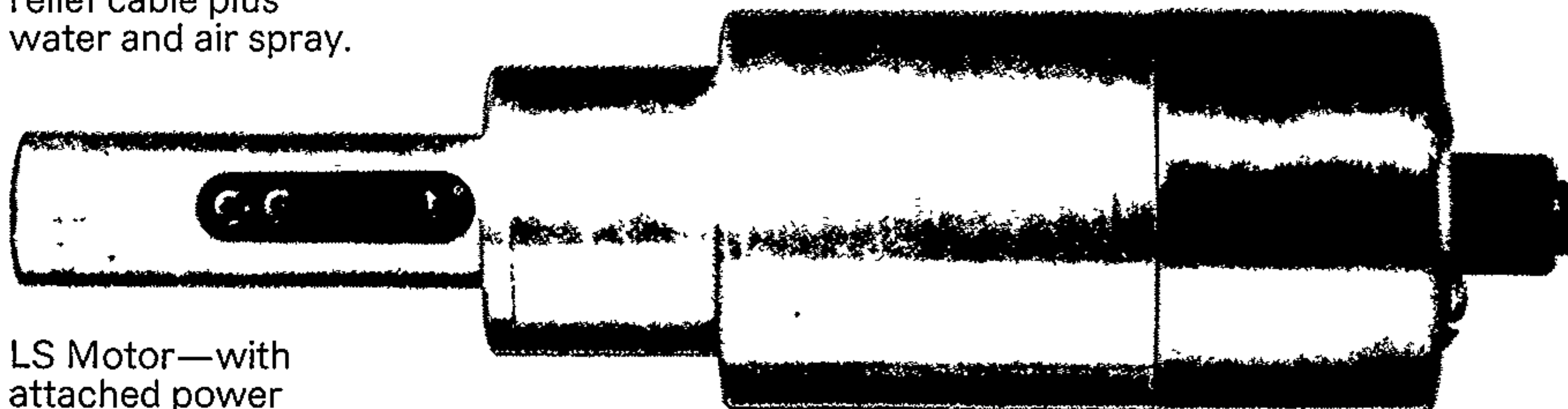
The Electro-Torque LS Motor is similar in size and weight to the A Motor. It is designed, however, to provide low speed (0 to 7,500 rpm) and exceptionally high torque (up to 9 inch-ounces). It's ideal for finishing the cavity preparation, for prophylaxis, and for trimming and finishing dental appliances. The LS/QD Motor has a quick disconnect for strain relief cable plus water and air spray.



A Motor—with attached power cord set.



A/QD Motor—with quick disconnect cord set for strain relief cable plus water and air spray.



LS Motor—with attached power cord set.



LS/QD Motor—with quick disconnect cord set for strain relief cable plus water and air spray.

Figure 20.

iv) Air-driven handpieces. In 1956, the first clinically successful air-driven handpiece became available, the "Borden Airotor" (R), with free running speeds of 300,000 r.p.m. A small compact unit consists of a handpiece, control box, foot control, and various connector hoses. When the foot control is activated, compressed air flows through the control box and is carried by a flexible hose to the back of the handpiece. From here the air is directed to the head of the handpiece and is blown against the blades of a small turbine to produce rotation. Some of the spent air is expelled through the head of the handpiece, while the greater part is exhausted at the back of the handpiece or returned to the control box. A one-sixteenth shank, rotary cutting instrument is inserted into the shaft of the turbine, and held by friction grip in a plastic chuck or wrench-tightened metal chuck. Air turbines have a low torque and will stall at lateral work loads of approximately four or five and one half ounces. (33)

Air bearings have been used instead of ball-bearings to support the turbine shaft in some air turbine angle handpieces. By having the turbine suspended in air and rotated by air, practically all friction is eliminated and speeds may be increased to over 800,000 r.p.m. Handpieces utilising this design are very quiet in operation.

The following tables (Tables 11,12) compare various handpieces. (34)

Low Speed Handpieces				
Length in.	Weight 5-1/4 oz.	SPEED 1000-7000 rpm	POWER SUPPLY Air-2.1 CFM	TORQUE 30-430 gm.-cm.
5 in.	5 oz.	Low Range * - 1200-9000 rpm High Range * - 2000-19,000 rpm	@ 35 psi Air-1.3 CFM @ 30 psi	10-115 gm.-cm.
5 7/8 in.	6-1/4 oz.	2000-30,000 rpm	Air-1.2 CFM @ 45 psi	160 gm.-cm. Constant
5 8 in.	5 oz.	2000-20,000 rpm	Elec.-110 Volt AC	30-190 gm. cm.
5 3/8 in.	6-1/4 oz.	Low Range * - 11,000-25,000 rpm High Range * - 19,000-29,000 rpm	Air-2.8 CFM @ 50 psi	50-190 gm.-cm.
6-9/16 in.	5-1/3 oz.	8500-23,000 rpm	Air-2.8 CFM @ 40 psi	30-13 gm.-cm.
5-15/16 in.		5800-15,500 rpm	Air-3.3 CFM @ 40 psi	
6-3/4 in.	5-1/2 oz.	0-20,000 rpm	Belt-Electric Motor-110 AC	180 gm.-cm. Constant

Table 11.

Table 12. High Speed Handpieces

	DENSCO "Q. T."	"Q. T." MIN.	BORDIN	WISPAIR	ENCOPE	MIDWEST MIN.	MIDWEST	WL3EF
Weight	47.15 gm.	46.28 gm.	68.25 gm.	65 gm.	48.0 gm.	53.3 gm.	55.4 gm.	57.0 gm.
Overall Length	5.562 in.	5.562 in.	5.937 in.	5.125 in.	5.312 in.	5.156 in.	5.156 in.	5.908 in.
Length (top of cap to end of std. 557 bur)	.843 in.	SS bur .687 in.	.885 in.	.875 in.	.906 in.	.625 in.*	.906 in.	—
Length (top of cap to end of rotor)	.531 in.	.437 in.	.613 in.	.562 in.	.625 in.	.362 in.	.605 in.	.537 in.
Length of shaft protrusion	.031 in.	.031 in.	.062 in.	.000 in.	.025 in.	—	—	—
Diameter of Head	.343 in.	.312 in.	.391 in.	.406 in.—.347 in.	.402 in.	.372 in.	.426 in.	.405 in.
Diameter of Neck	.312 in.	.312 in.	.312	.343 in.	.250 in.	.182 in.	.267 in.	.335 in.
Speed (rpm × 1000)								
10 psi	245	250	175-280	150	200	220	220	61.5
20 psi	315	305	200-350	250	320	310	285	150.00
30 psi	370	360	240-375	310	360	350	375	198.00
40 psi	—	—	—	355	400	—	—	226.5
50 psi	—	—	—	360	410	—	—	—
Flow (cfm)								
10 psi	.620	.550	.620	.30	.540	.568	.718	.593
20 psi	.960	.810	.950	.55	.790	.866	1.190	.731
30 psi	1.205	1.070	1.250	.80	1.077	1.121	1.634	1.017
40 psi	—	—	—	.98	1.300	—	—	—
50 psi	—	—	—	1.15	1.505	—	—	—
Torque								
% of Optimum	90%	80%	100%	80%	80%	65%	85%	80%

* Mfr's bur

Table 12.

STERILIZATION

Great advancement in methods of sterilization of instruments and equipment have been made in recent years, with aseptic operating conditions being vigorously pursued in hospital surgical units. Central sterile supply departments have been set up to supply pre-packed sterile instruments and materials and there has been increasing use of disposable equipment, pre-sterilized with gamma radiation. (29)

Sterilization is defined as the complete destruction of all forms of micro-organisms, whereas disinfection is the destruction of pathogenic organisms in the non-sporing or vegetable state. Sterilization, rather than disinfection, is mandatory whenever tissue is penetrated or there is contact with blood or serum, a common occurrence in routine dental surgery.

The various methods of sterilization are:-

a) Dry Heat

i) Direct heating. This method does not sterilize unless the object being heated becomes red-hot. This will effect the temper of the metal and is not recommended for dental instruments.

ii) Flaming. When cotton-wool pledgets, Dappen dishes or glass slabs are coated with alcohol which is then ignited, surface organisms are destroyed. This method is of limited value and should be used only for previously sterilized materials.

iii) Molten metal, glass beads, ball bearings, hot salt. All these materials, contained in a small heated vessel, have been used to sterilize small instruments and materials e.g. in root canal therapy.

iv) Hot air oven. This is the most reliable method.

The oven should be electrically heated and, in the case of large ovens, provided with a fan to ensure even distribution of heat. An external thermometer and a time switch are essential. A temperature of 160 deg.C held for one hour will sterilize the oven contents. These ovens are now readily available and being light in weight are suitable for a portable situation.

v) Hot Oils. These have been suggested for sterilizing geared instruments such as dental handpieces, but due to the poor penetrating power of the oils and dubious sporicidal effect, is not regarded as being a good method. Hot oils should never be used for syringe sterilization due to the risk of oil embolism.

b) Moist Heat

i) Boiling water. This method does not sterilize but only disinfects so that a false sense of security is engendered by the use of the "boiler". If no other more effective method, such as dry heat or autoclaving is available, boiling water may be used provided its limitations are clearly understood. Most vegetative organisms will be destroyed by immersion for 5 minutes in water at 100 deg.C but boiling water is unreliable against spores and some viruses. (28)

ii) A.C.I O.(Surgical) solution. This is an oil emulsion used with boiling water and sodium carbonate, specifically for the sterilization of dental handpieces. It will disinfect and lubricate efficiently.

iii) Autoclave. This is an apparatus to sterilize instruments and materials by pressurised steam. The pressure serves merely to raise the operating temperature and by itself makes no contribution to the sterilizing process. Steam is a gas which will condense easily on cold surfaces to form water, releasing latent heat. It

rapidly penetrates porous materials and raises their temperatures. There are two main types of autoclave: the downward displacement type, in which the air within the chamber is displaced by the entering steam, and the high-vacuum type in which the air in the chamber is evacuated by a pump before the steam is permitted to enter. It is usual to operate the autoclave at 30-33 lbs.per sq.inch pressure. At 32-35 lbs.pressure a temperature of 134 deg.C should be recorded in the discharge line and a sterilizing time of 3 minutes used. The holding time is determined by adding a margin of 50 per cent for safety. Corrosion of metal instruments during autoclaving may be overcome by the use of paper impregnated with a vapour phase inhibitor. Testing of autoclaves and hot air ovens may be done by the use of Browne's Tubes. (Type 1)

c) Radiation

i) Ionising: Gamma radiation.

Due to the high cost of installation, only a few large scale plants have been set up which sterilize great quantities of disposable instruments and materials for medical use. In these plants cobalt 60 is the main source of gamma-radiation. It is likely that an increasing amount of disposable dental materials and instruments will be sterilized by this method and delivered in sealed containers.

ii) Non-ionising: Ultra-violet light.

This is used to reduce air-borne bacteria counts in hospitals and the emitting lamps are sited over radiators, or, in a ducted air system, on the clean air side of the filter at right angles to the air stream. Due to poor penetration power, this method is not suitable for instrument sterilization.

d) Chemical

i) Solutions. In the past, many chemical solutions have been used in an effort to find a convenient method for cold sterilization, and it is now generally accepted that physical means, such as steam, dry heat, and irradiation, have superseded them. There is, however, a place for these solutions in treatment of the environment and skin surface. Alcoholic Chlorhexidine (0.5 per cent Hibitane gluconate 20 per cent W/V in 70 per cent alcohol) is popular.

ii) Gases. The most commonly used are formaldehyde and ethylene oxide. The use of low temperature steam and formaldehyde for sterilizing heat sensitive materials may be of increasing use in dentistry. Ethylene oxide at room temperature is an explosive gas which is soluble in water, rubber and many plastics, but does not damage any materials with which it may come in contact. It has only limited application.

Abel et al have examined the area of bacterial contamination by water from dental units delivered from air-turbine handpieces and water-spray syringes. Studies found massive bacterial contamination of these water supplies. (30) He recommends the use of a plastic tank to dispense chlorinated water at 50 p.p.m of available chlorine.

The method of choice in a portable and mobile context would seem to be, boiling water sterilizer, hot-air oven, autoclave, increasing use of pre-sterilized, disposable equipment and materials, and the provision of a potable water supply to the patient.

DISPOSABLE EQUIPMENT

Over the past few years a big development in the use of disposable equipment has taken place. This has an advantage in considering portable equipment, as first of all, it can be pre-sterilized and packed ready for use and by being disposed of after use, does not have to be transported back to base. These items include disposable saliva ejectors, needles, syringes, mirrors, scalpels, paper cups, towels, gowns and impression trays. It is anticipated that further developments along these lines will take place. (Vol.2, Plate 6)

D. Types - Laboratory.

The same principle of ergonomics, work simplification, and environment apply to the dental laboratory as to the surgery. Vol.2, Plate 9 shows poor conditions in a dental laboratory with the R.A.A.F in Morotai in 1944.

The aim should be to provide the dental technician with a well-lighted, well ventilated dental laboratory with adequate work space and good seating posture, in order that he may produce his best work. This situation can be seen in Vol.2, Plates 72,73 in a modern mobile laboratory in the R.A.A.F. Comparison of the two situations will show the remarkable change in concepts of portable laboratory facilities that have taken place.

As to dental equipment, in addition to the normal hand tools in use in dental laboratories the following should be provided:

- i) A dental lathe or engine
- ii) A hanging dental laboratory motor on a bracket, with either foot or knee control. Vol.2, Plate 10
- iii) Casting equipment, either hand operated centrifuge or preferably an automatic centrifuge of the "Torit" type.
- iv) Furnace, either electric or gas operated.
- v) Facilities for storage of plaster, investment, fuel etc as well as tooth cabinet and other equipment containers.
- vi) Acrylic curing tank
- vii) Bunsen burner - with bottled gas or spirit lamp.
- viii) Model trimmer.
- ix) Water facilities.
- ix) Refrigerator - where possible, particularly in tropic areas to prolong the shelf-life of the various dental materials.

A mobile laboratory as outlined, is shown in Vol.2, Plate 72, and is currently in service with the R.A.A.F.

Plate 11 shows that basic dental laboratory equipment can be carried in a case.

There is no reason why the dental laboratory should be neglected in the development of portable dental equipment, if the whole dental team is to deliver the best service to the patient.

E. Types - Operating Theatre.

There is a requirement for special types of equipment for use in operating theatres for oral surgery, operative dentistry etc performed under general anaesthesia.

Because of the nature of the environment encountered in this situation special equipment has been developed.

- i) Surgical aspirators - these should be noiseless, vibration free and flameproof, as with the presence of oxygen and other explosive gases, the electrical equipment should be spark free.
- ii) Laboratory engine or suspended motor, with a cable arm that can be sterilized, for use in oral surgery.
- iii) Mobile gas (preferable CO₂) driven air rotors for use in operative dentistry.
- iv) Mobile X-Ray equipment, including rapid development facilities.

5. Patients requiring the use of this equipment

The basic policies of the American Dental Association on public and private responsibility for dental care are:-
 "Dental care should be available to all regardless of income or geographic location as rapidly as resources will permit. Private and community programs should provide for priority dental treatment, prevention and control of dental disease in children, and for the elimination of pain and infection in adults." (38)

a) Chronically ill, aged and handicapped

In the U.S. of the millions of individuals who benefit from the services of public health personnel, an estimated 1,700,000 truly are chronically ill and handicapped. (39)
 The care of these people is becoming increasingly effective because of team-work on the part of many agencies. Through co-operative efforts and the application of the individual skills of those concerned about health, the outlook for rehabilitation invariably improves. To achieve dental care for the aged, considerable dependence on joint effort stands out as a demand.

The development of portable equipment permits the dentist to bring dental care to the homes of chronically ill, aged and handicapped patients. Departments of health, dental societies and community agencies have purchased equipment and developed projects to provide the care. (40)
 Leaving the familiar setting of the surgery to work at the patient's home is a new experience for the dentist. Working in this unfamiliar setting has been simplified by recent developments of portable units. Slow-speed laboratory engines with makeshift sources of light have been replaced by medium-speed, self contained units.

Portable turbines, powered by carbon dioxide carried in cylinders permit dental treatment in the home that can keep abreast of developments in high-speed equipment in the surgery.

Vol.2, Plate 12 has a medium-speed Ritter Portable "A" unit, weighing 40 pounds, costing \$800 approximately, includes an engine, light, aspirator, and air syringe, all housed in a suitcase-like container. Turbine units range in price from \$950 - \$1,200 and weigh 45 pounds. The cylinders store sufficient carbon dioxide for two hours of operation.

As antibiotics and intricate surgery prolong the lives of physically and mentally handicapped children, the problems in their dental treatments, such as gaining a knowledge of each child's medical history, the possibilities for employing preventative therapy and the appropriate operative procedures to select, all become acutely apparent. The Department of Mental Health, State of Michigan, estimated in 1970 there were 259,000 mentally retarded persons in that State and a study of the dental problems of non-institutionalized mentally retarded children showed that only 17 per cent of the decayed, missing and filled teeth had been treated as compared with 50 per cent of the normal population. Any treatment undertaken was usually for an emergency. (41)

A study of handicapped children by Horowitz and Hoag, showed a marked proclivity toward gingival disease. (42) When the entire problem of the handicapped is considered, it becomes clear that most people are handicapped in some small way. The degree of handicap is the all-deciding factor as to whether a person can compete on a fairly even basis with other members of society. At one time it was felt that the severely handicapped should be literally

isolated from society. This philosophy is changing, and the severely handicapped are becoming accepted as part of society. These are the people that can be treated with portable dental equipment in their own environment. (43)

Because of the added emphasis on program for the treatment of the chronically ill and aged, still further technological advances are to be expected. The development of new techniques of treatment are also necessary. The homebound patient is either confined to bed or to a wheelchair. The variations of techniques are concerned mainly with positioning of the patient, the position of the operator with respect to the patient and the placement of the equipment. Portable equipment has now been designed similar to surgery equipment except that it is compact and light in weight. (44)

The principle responsibility of dentists toward the ageing patient is to provide care for acute inflammatory conditions, to maintain and retain the residual oral structures and to restore teeth adequately for ingestion of food. Studies at several metropolitan hospitals (44) reveal that many patients do not ingest foods because of poor dental health.

b) Institutionalized

In the U.S.A., state and local agencies have assumed direct responsibilities for a large number of individuals who are institutionalized in hospitals, prisons and institutions for the care of mentally retarded. It is estimated that more than one million persons are confined to these types of institutions. (46) Unfortunately, dental services in institutions tend to be minimal, e.g. relief of pain. However, with portable equipment

treatment can be taken to the patient. Vol.2, Plate 13

Boller and Posnick have described the improvements in hospital operating room dental equipment so that they now have dental X-Rays, high-powered air compressors and suction devices in the operating rooms, so that there is only a minimum of equipment movement, no matter how complicated the dental procedures. (47)

c) Indigenous people

Many westernised countries have indigenous people, e.g. Australia, Canada, U.S.A., to which the respective governments have a responsibility for dental health. Often these groups are in the remote areas of the country and require mobile and portable equipment to render dental treatment. Davey has described (48) a complete, self contained field unit for the treatment of Indians in Northern Ontario, with portable equipment that packs into suitcases. Vol.2, Plate 14.

d) Schoolchildren

All States and Territories of the Commonwealth of Australia provide dental treatment to schoolchildren to a varying degree. State clinics are used, but also dental caravans in some areas and portable dental equipment in remote areas are provided. This equipment is described in Chapter 10 of this thesis.

e) Armed Forces

All three Australian Armed Services, provide for field treatment using mobile and portable dental equipment. Because of the different conditions operating in the three services, a comprehensive range of mobile and portable equipment is provided, so that the full range of dental services can be provided, even under the most trying conditions (49). This is covered in detail in Chapter 10.

The level of sophistication of treatment must be considered, for in general, the type of portable equipment assembled, the environment, the conditions under which dental treatment is carried out, the laboratory facilities available, will all contribute to determine the level of treatment, not of course the standard of treatment.

With modern mobile equipment now available the level of treatment depends on the aim of the dentist and/or the organization undertaking the treatment. However, dependent on financing of this treatment, the level of sophistication can be as good as that found in static clinics. See Vol.2, Plate 76.

6. TRANSPORTATION OF PORTABLE EQUIPMENT

While transportation in itself is merely the means of taking portable equipment from its base to its site of operation, the transportation facility can determine the size, weight and shape of the equipment to be transported.

Methods of transportation

i) Sea. In ships at sea, particularly warships, the "top-side" weight is critical, so that equipment so placed should be of minimum weight. Also, because the access to the dental surgery in a ship is usually through the hatches and along narrow companion-ways, the size and shape is restricted. Usually transformers have to be used, to set up the ship's power to the operating power of the dental equipment. Vol.2, Plates 15,16, show the working conditions that can be experienced on ships.

ii) Air. Once again the weight is critical and must be known exactly in order to compute fuel requirements of the aircraft, centre of gravity, range etc. Also, the access doors and ramps to the cargo bay of the aircraft may determine the type of equipment that can be carried. Vol.2 Plate 69 shows a dental surgery module being loaded on a R.A.A.F. "Hercules" aircraft. (50) The dimensions of this R.A.A.F. air-portable dental clinic are:-

Overall length - 20' 0"

Overall width - 9' 6"

Overall height - 8' 3"

All-up weight - 7,500 lbs.

Vol.2, Plates 17,18, shows transport by helicopter. In light aircraft used by the Royal Flying Doctor Service, the above considerations assume greater importance when disassembled equipment is to be transported, and the design of this equipment may have to be modified in order to fit into the aircraft.

iii) Road. Equipment is usually transported by prime-mover, trailer or by caravan. These also have a maximum allowable width, length and weight but obviously not as critical as sea and air. Vol.2, Plates 23 - 26, show typical caravan and trailer transportation. Also a station sedan can be used to carry a portable surgery contained in boxes and crates. Vol.2, Plates 19-22 show this arrangement.

iv) Rail. Usually standard size rail-cars are used, as supplied by the Railways Department. There are obvious restrictions as to size and weight but the size of the rail-cars give plenty of scope in comparison with other forms of transport.

In all forms of transport the equipment must be well packed, tied down or firmly bolted to the floor of the vehicle to prevent damage.

7. LOCATIONS FOR USE OF PORTABLE DENTAL EQUIPMENT

- i) Disassembled. In general there are several main situations, e.g. where the portable equipment is brought to the area of operation in a disassembled condition and then assembled to form an operating surgery in a room allotted for the purpose. This situation is often seen in schools. Many modern schools now have a room designated as a "medical room" and this is often satisfactory in that it has water, a sink, electricity and good lighting. Vol.2, Plates 27,28 show a typical set-up of this type of equipment.
- ii) Modular. However, the above type of "setting up", is largely on the way out, to be replaced by mobile caravans, trailers, rail-cars etc, that can bring the dental surgery intact, as a module, to the site of operation. Vol.2, Plate 25, show these modular surgeries.

These types of "packaged surgeries" are usually set up in a shaded area near a source of power and water or on the deck of a ship as a complete unit. Vol.2, Plate 74 shows a typical set-up of a R.A.A.F. modular dental clinic.
- iii) Hospital. As well as static surgeries in a hospital situation there is a need for portable equipment in both the operating theatre and for use in the wards for bed-patients. Mobile consoles such as shown in Vol.2, Plates 29,30 can be wheeled in the operating theatre and "packaged equipment" such as shown in Plate 12 can be used for bed patients.
- iv) Home-visits. For patients in this situation there are "surgeries in a suitcase" type of portable equipment to render the required treatment and this is shown in Vol.2 Plate 31,32.

8. MANUFACTURERS AVAILABILITY OF EQUIPMENT

1) Specifications. In regard to specifications, quality control and tariff control of dental equipment and materials, the Australian Dental Association in its Constitution and By-Law of 3rd April 1971 states in paragraph 8:-

"8 DENTAL MATERIALS COMMITTEE

Composition (a) The Federal Council shall elect a Committee of up to eight members to be known as the Dental Materials Committee and no member of the Committee shall have any direct financial interest in any dental manufacturing business or supply house.

Duties (b) (i) To evaluate, maintain and improve the quality of dental materials, equipment and therapeutic substances available in the Commonwealth by establishing standards and accrediting dental products.

(ii) To publish a list of such dental products as have been accredited.

(iii) To initiate requests for specifications to be drafted by the Standards Association of Australia and also any modifications thought to be necessary to existing standards.

(iv) To establish liaison with and where necessary seek collaboration and advice of the Commonwealth Bureau of Dental Standards and other appropriate organisations in matters relating to the testing of dental products.

(v) To appoint a panel of co-operating practitioners throughout Australia to act as clinical advisers and also to participate in such clinical testing programmes as the Committee may request.

(vi) To stimulate and collate research in Dental Materials and Therapeutic Substances used in the practice of dentistry.

(vii) To carry out such other functions as may be referred to it from time to time by the Federal Council or the Federal Executive.

9. DENTAL TARIFFS COMMITTEE

Composition (a) The Federal Council shall elect a Committee of up to five members to be known as the Dental Tariffs Committee.

Duties (b) (i) To establish liaison with dental trade houses in order to encourage and develop satisfactory relations between the dental profession and the various organisations representing the dental trade.

(ii) To study the effect of tariffs and duties applied to imported dental products and equipment and to recommend appropriate action to the Federal Executive."

Other organisations, such as the Commonwealth Bureau of Standards and the Standards Association of Australia also have an interest in the specifications of dental equipment and materials.

CLASSIFIED LIST COMMONWEALTH BUREAU OF STANDARDS (TABLE 13)

Acrylic & other Resins

Denture Base AS 1043
 Denture Repair AS T31
 Direct Filling
 Composite Resin To be AS 1278
 Teeth AS T20

Amalgams

Alloy AS T2
 Mercury AS T1
 Anaesthetics, Local AS T19

Casting & Wrought Alloys

Cobalt-Chromium AS T28
 Denture Casting Gold AS T13
 Inlay Casting golds AS T12
 Wrought Gold AS T9

Cements

Orthodontic Band To be AS 1253
 Silicate AS T8(AS.....)
 Silicophosphate AS T8(AS.....)
 Zinc Phosphate AS 1186

Endodontic Materials

Gutta Percha Points To be AS 1258
 Rubber Dam AS 1022
 Filling Materials

Amalgam: Alloy AS T2
 mercury AS T1
 Composite Resins To be AS 1278
 Silicate Cements AS T8(AS.....)
 Silicophosphate Cements AS T8(AS.....)

Gypsum Products

Artificial Stone AS T7
 Casting Investment AS T22
 Impression Plaster AS T4
 Laboratory Plaster AS T5
Impression Materials

Agar AS T16
 Alginate AS 1282
 Baseplates AS 1241
 Duplicating material AS 1097
 Elastomeric AS 1185
 Impression Paste AS T18
 Modelling Compound AS T6
 Plaster AS T4
Instruments

Chisels, Excavators, Probes & Scalars AS 1086
 Hypodermic Needles AS T24
 Rubber Dam Punches AS 1283
 Shanks & Chuck AS 1093
 Fittings for Rotary Instruments
 Single-Use Needles AS 1264
Orthodontic Materials

Band Cements To be AS 1253
 Latex Elastic Bands To be AS 1240
 Wires AST 32

CLASSIFIED LIST COMMONWEALTH BUREAU OF STANDARDS (TABLE 13) (Continued)

<u>Rubber Dam</u>	
<u>Solders</u>	
Gold	AS T26
Silver	AS T30
<u>Toothbrushes</u>	AS T032
<u>Waxes</u>	
Inlay Casting	AS T14
Modelling	AS T17
Sticky	AS T10
<u>X-Ray Films</u>	AS 1139

LIST OF DENTAL AUSTRALIAN STANDARDS - JULY 1972

Those standards marked * are under review and may eventually have new numbers in the metric "1000" series, AS

NUMERICAL LIST

*AS T1	Mercury	AS 1086	Chisels, Excavators, Probes
*AS T2	Amalgam Alloy		& Scalers (formerly AS T23)
AS T4	Impression Plaster	AS 1093	Shanks and Chuck Fittings
AS T5	Laboratory Plaster		for Rotary Instruments
*AS T6	Modelling Compound	AS 1097	Duplicating Materials
AS T7	Artificial Stone	AS 1139	Intra-Oral X-Ray Films
*AS T8	Silicate and Silicophosphate		(formerly AS T21)
	Cement (To be AS)	AS 1185	Elastomeric Impression Materials
AS T9	Wrought Golds		(formerly to be AS T27)
AS T10	Sticky Wax	AS 1186	Zinc Phosphate Cement (formerly
AS T12	Inlay Casting Golds		AS T3)
AS T13	Denture Casting Gold	To be AS 1240	Latex Elastic Bands for
*AS T14	Inlay Casting Wax		Orthodontic Use (in preparation)
*AS T16	Agar Impression Material	To be AS 1241	Baseplates
AS T17	Modelling Wax	To be AS 1258	Gutta Percha Points
*AS T18	Impression Paste		(in preparation)
*AS T19	Local Anaesthetics	AS 1264	Single-Use Hypodermic Cartridge
AS T20	Acrylic Resin Teeth		Needles (formerly to be T57)
AS T22	Casting Investment	To be AS 1278	Direct Filling Composite
AS T24	Hypodermic Needles (re-usable)		Resin (in preparation)
AS T26	Gold Solder	AS 1282	Alginate Impression Material
AS T31	Cold-Processing Resins for		(formerly AS T15)
	denture repairs	To be AS 1283	Rubber Dam Punch
AS T32	Orthodontic Wires		(in preparation)
AS 1022	Rubber Dam		
AS 1032	Toothbrushes		
AS 1043	Acrylic Denture Base Resin (formerly AS T11)		

In addition to this committee, the Standards Association of Australia has recently set up Committee DN/14/1 to prepare specifications for operating lights. Another committee, EL/18/8 is dealing with dental X-Ray equipment. However, according to Mr. Alan Docking of the Commonwealth Bureau of Standards (51) there are very few standards available on dental equipment. Shown in Table 13 are standards currently in use for dental materials and some minor equipment that is currently being used. Also an International Standardization Organization Committee (ISO/TC 106 Working Group 5) has been involved in the classification of dental equipment, but, as yet only preliminary drafts have been brought out. This Committee is working in co-operation with the F.D I. and they bring out reports from time to time. (52)

The American Dental Association has a Council on Dental Materials and Devices, which provide the profession with reliable information on the status of recently developed devices that are of important significance in dental practice and in the maintenance of oral health. In evaluating new items, special emphasis is placed on consideration of evidence of safety under conditions of use. Decisions of the council are based on available scientific evidence and are subject to reconsideration at any time.

In general, manufacturers supply, with the equipment, a list of specifications, together with care and maintenance instructions. The user should read this very carefully before using specific equipment.

ii) Availability: The various types of equipment presently available will now be examined.

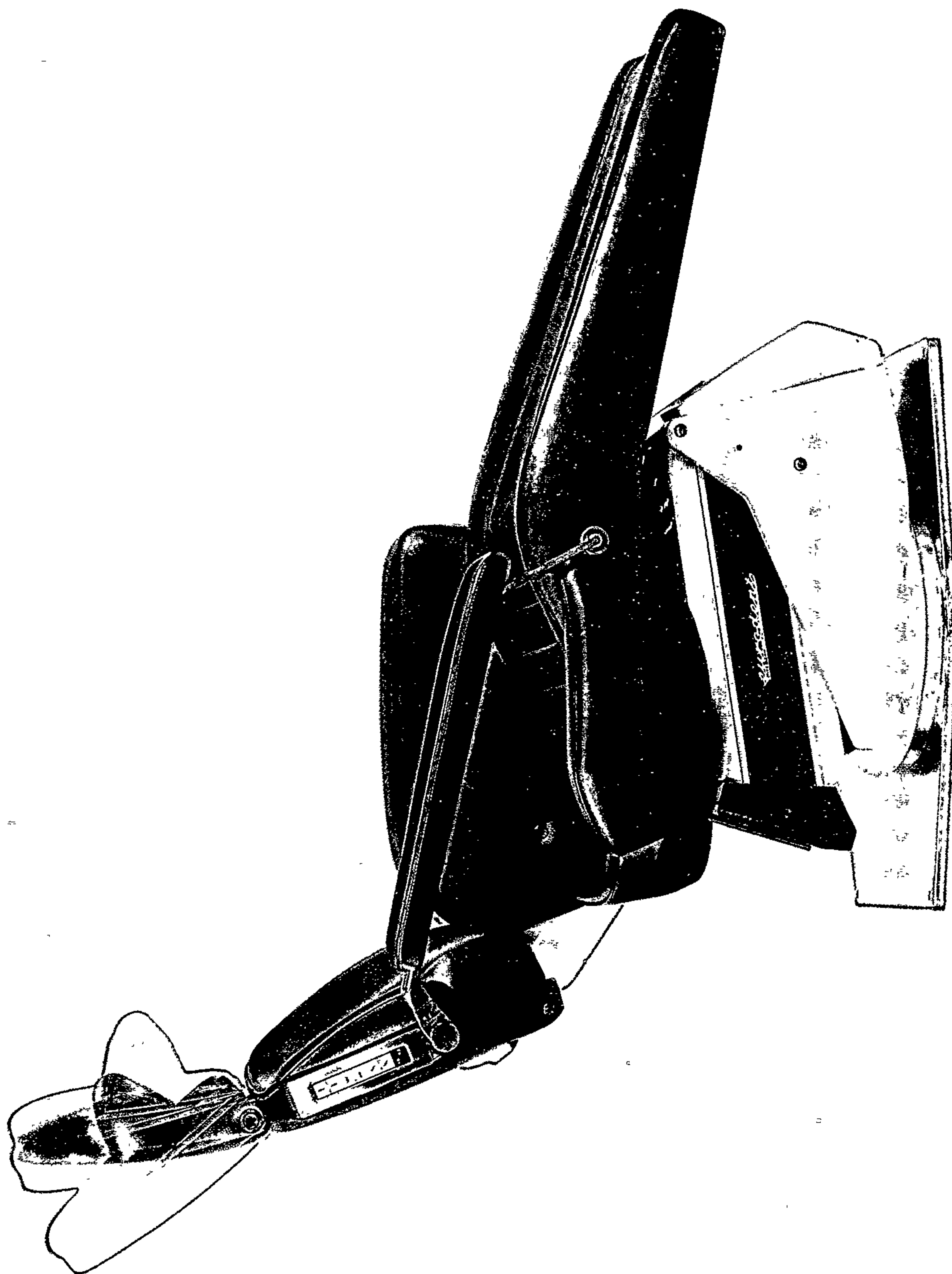


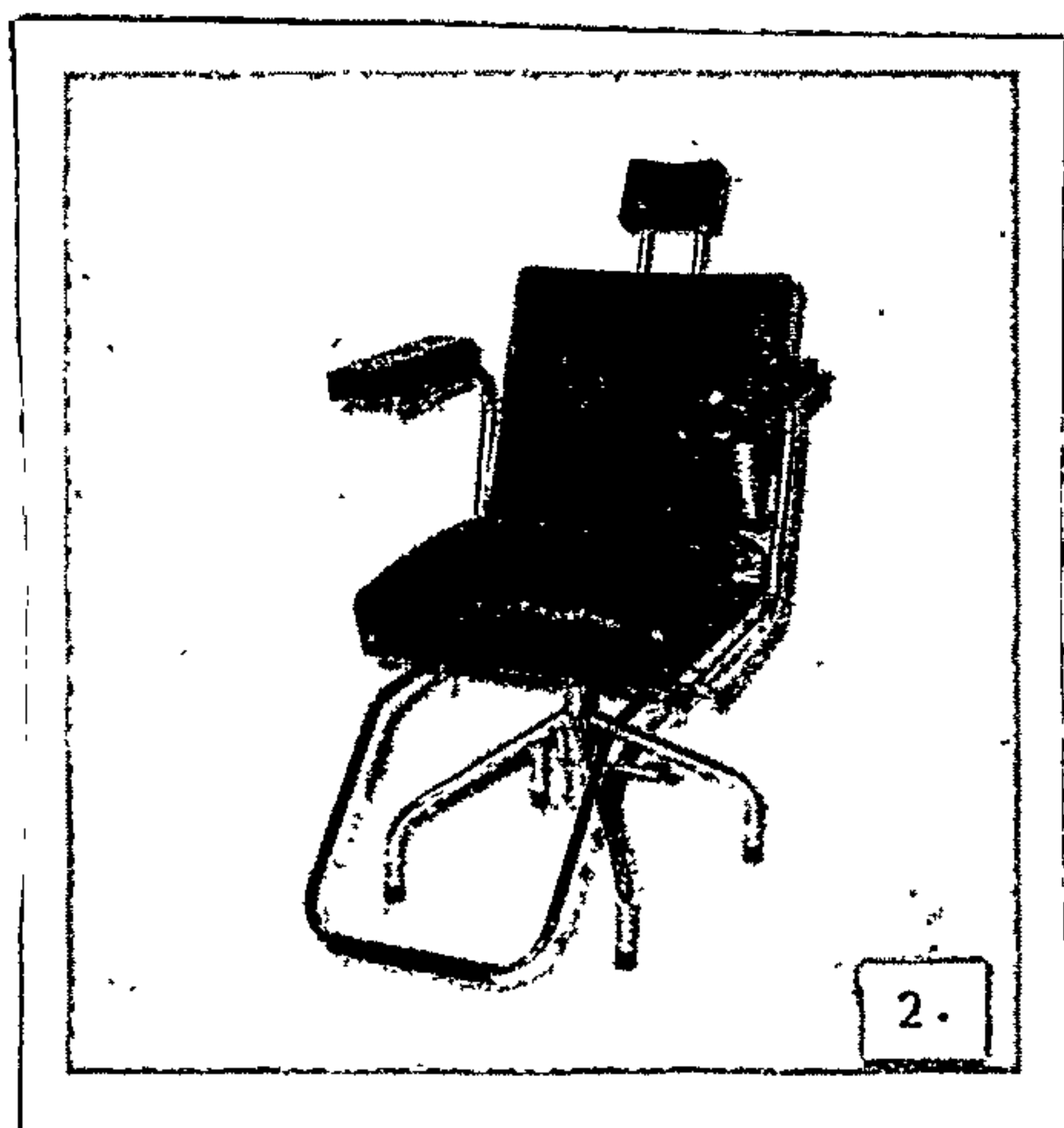
Figure 21.

a) Dental Chairs - Conventional.

Manually operated hydraulic dental chairs are still being used in transportable facilities. Vol.2, Plate 26 shows this type in place in a caravan. These chairs can also be converted into a semi-contour chair, which are very good for treating children. Some fully contoured chairs have a manually operated hydraulic base. The fully automatic contour chair can be used in a transportable clinic. This is shown in Vol.2, Plate 70 in use in the dental module used by the R.A.A.F. Vol. 2, Plate 33 shows the latest Siemens T3 chair. Figure 21 shows a typical modern contour chair, that can be used in caravans, trailers etc.

Dental Chairs - Portable

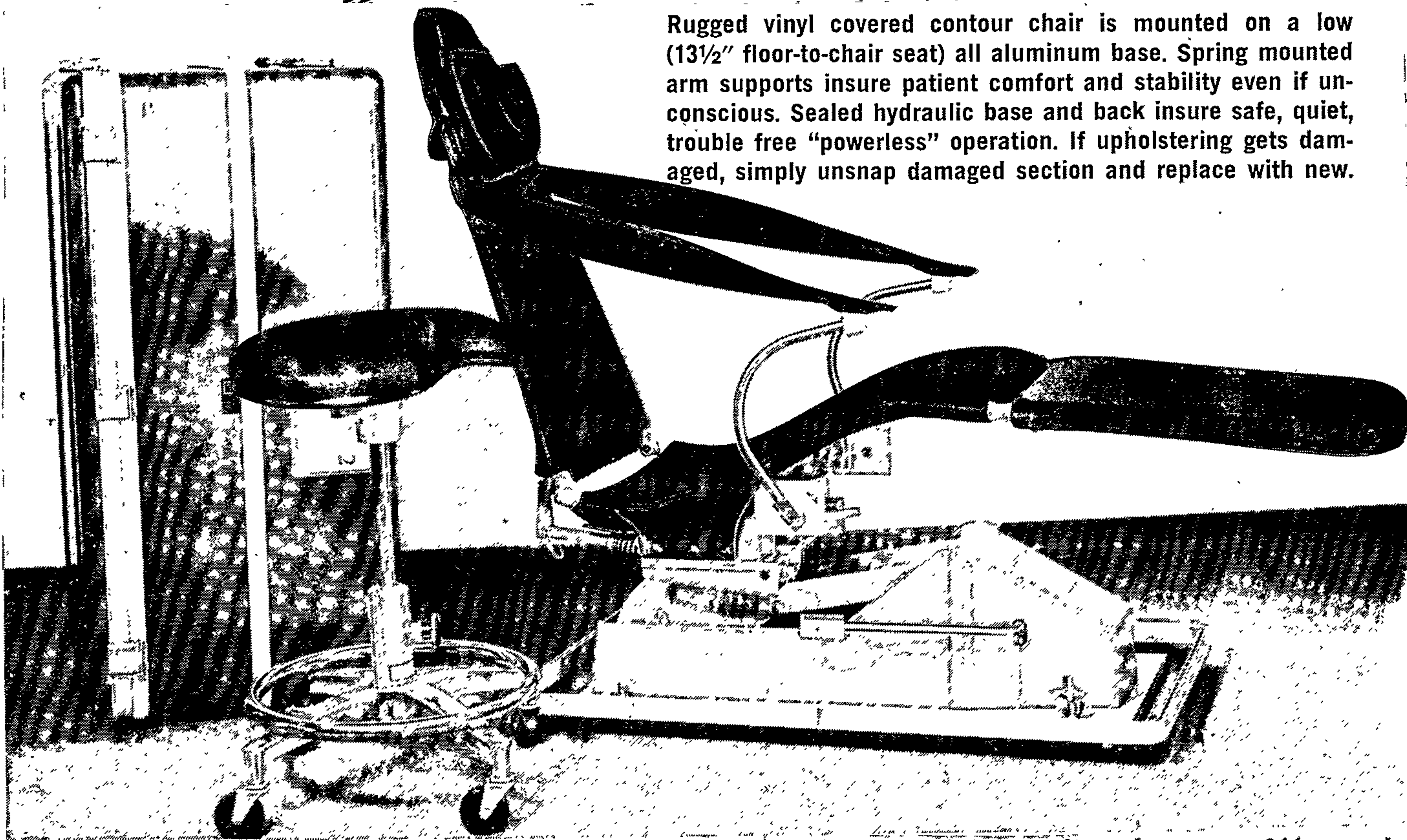
Tubular steel or aluminium chairs have been made in various sizes and shapes. They can be disassembled and stored in a canvas bag. Vol.2, Plates 22,28,34 show this type of portable chair. They have the disadvantage of unsuitability for sit-down four handed dentistry, general lack of postural alteration, and are not strong or rugged enough to stand up to the work-load. Figure 22 shows a tubular steel, chrome-plated chair made by Jarvis Tubular Products, Sydney.



PORTABLE DENTAL CHAIR
Back-rest, Head-rest & Foot-
rest are all adjustable. Finish
of tube is chrome - plated.
Seat height is adjustable from
19" to 24". Ideal for the extra
surgery, X-rays & examinations.

Figure 22.

A major development in a portable dental chair has been made by Den-Tal-Ex/A-Dec, U.S.A., with a contour chair that can be carried in a case, total weight 159 lbs. This is shown in Figure 23 and set up in Vol.2, Plates 35



Rugged vinyl covered contour chair is mounted on a low (13½" floor-to-chair seat) all aluminum base. Spring mounted arm supports insure patient comfort and stability even if unconscious. Sealed hydraulic base and back insure safe, quiet, trouble free "powerless" operation. If upholstery gets damaged, simply unsnap damaged section and replace with new.

Figure 23.

Total weight of three-unit package	311 pounds
Compressor with case	90 pounds
Field unit with case	62 pounds
Chair, stool, base with case	159 pounds

Dental Units:

There can be;

Fixed units:

- floor mounted
- cabinet mounted

Mobile units:

- on stands with wheels
- in mobile cabinets

Chair-mounted units:

- arm manifolds
- back-of-chair assemblies
- front mounted on telescoping arm.

Fixed units are usually supplied in caravans, trailers, rail-cars etc, and are only moveable if the whole clinic is moved.

In regard to truly portable units, there are three types.

i) Mobile carts and cabinets - these can be completely self contained using compressed gas in cylinders (e.g. CO₂) to run the systems, supplied with electricity from either a power supply or portable generator. In four-handed dentistry, there is a cart for the operator and one for the assistant - the so-called "his" and "hers" carts by Encore, as shown in Vol.2, Plates 29,30.

An A-Dec Hospital cart with CO₂ cylinder for use in an operating theatre is shown in Vol.2, Plate 36. Also an assistant can use a mobile cabinet as shown in Plate 37. Other makes of mobile cart are shown in Plates 39 - 42.

The standard portable air-rotor as used by Australian Armed Forces is shown in Figure 24. These are self-contained having their own air-compressor. Vol.2, Plate 38 shows the KAVO 652 with inspection plate removed. Also seen modified with micro-motor and triplex syringe in Vol.2, Plates 43,44.

Plate 46 shows the Sylvestair SW3 bracket model which can be run off compressed CO₂ or air and having its own water reservoir. Plate 47 shows the simplicity of its interior part. This unit can be mounted by bracket, straight onto the gas cylinders.

Plate 42 shows a mobile cuspidor unit, with separate unit for high-speed, low-speed, triplex syringe by the Ash Company, with "Telstar" fully automatic contour chair.

Plate 45 shows a "Rotobyne" mobile aspirator.

An example of the mobile cart type is shown in Figure 25.

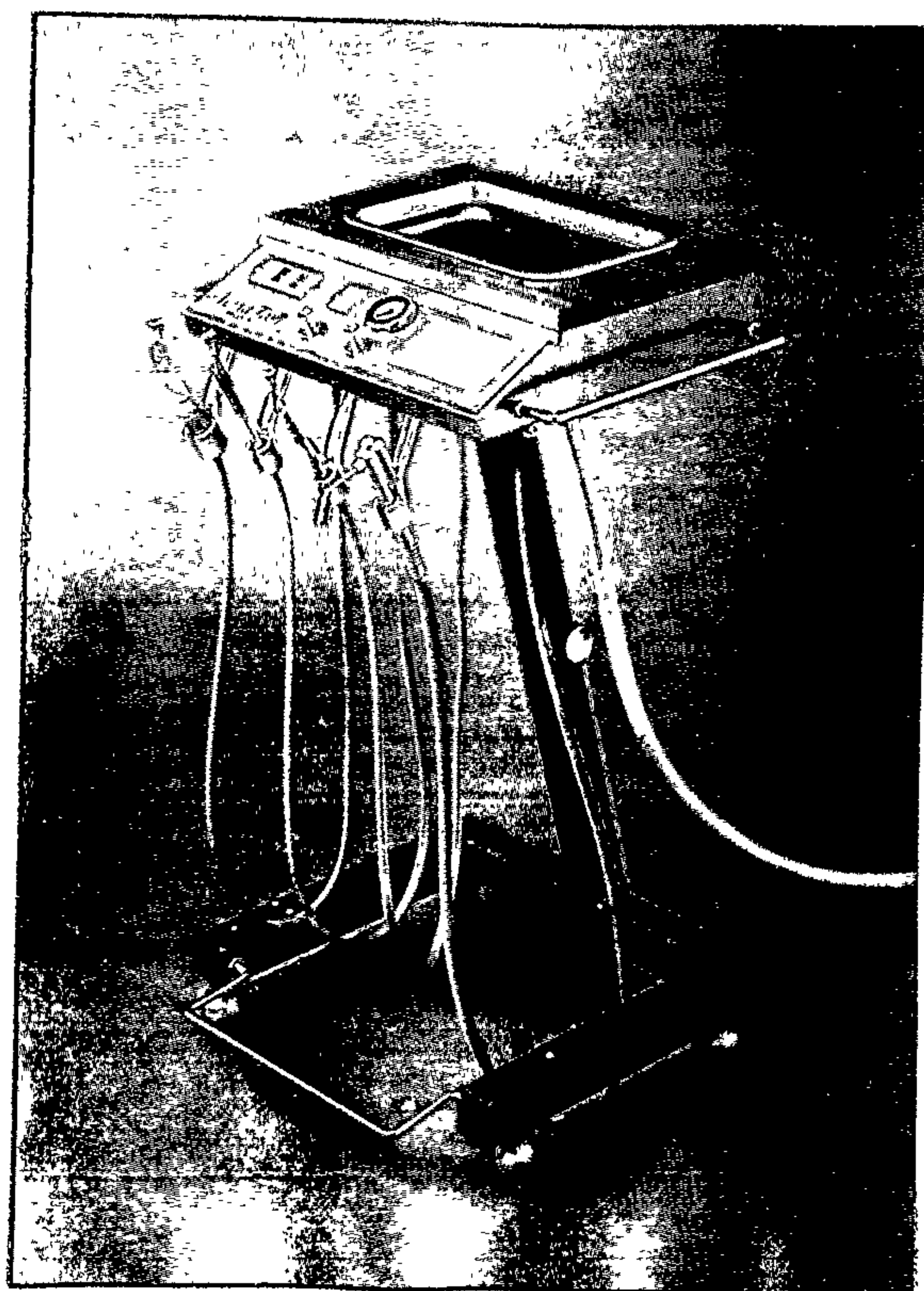
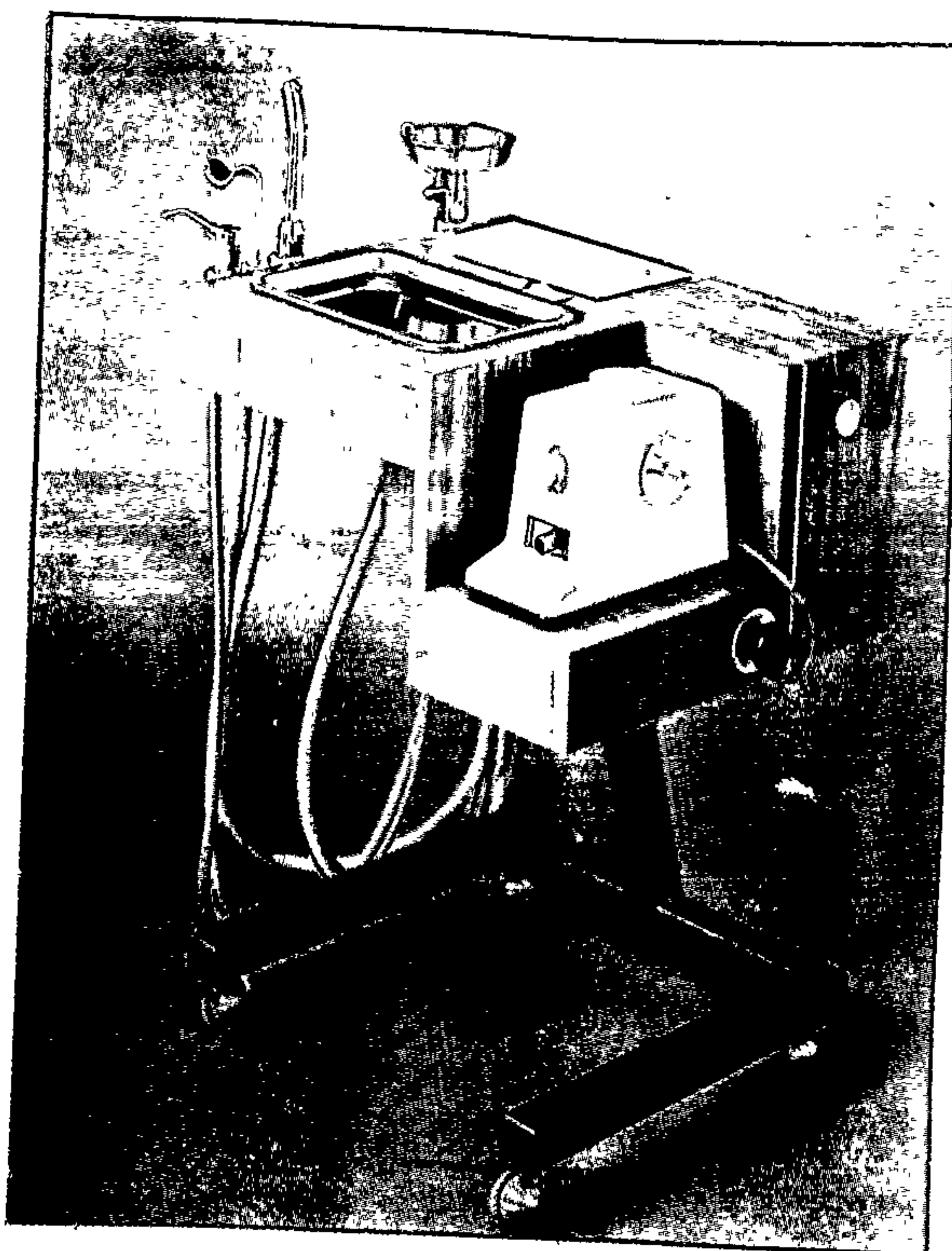
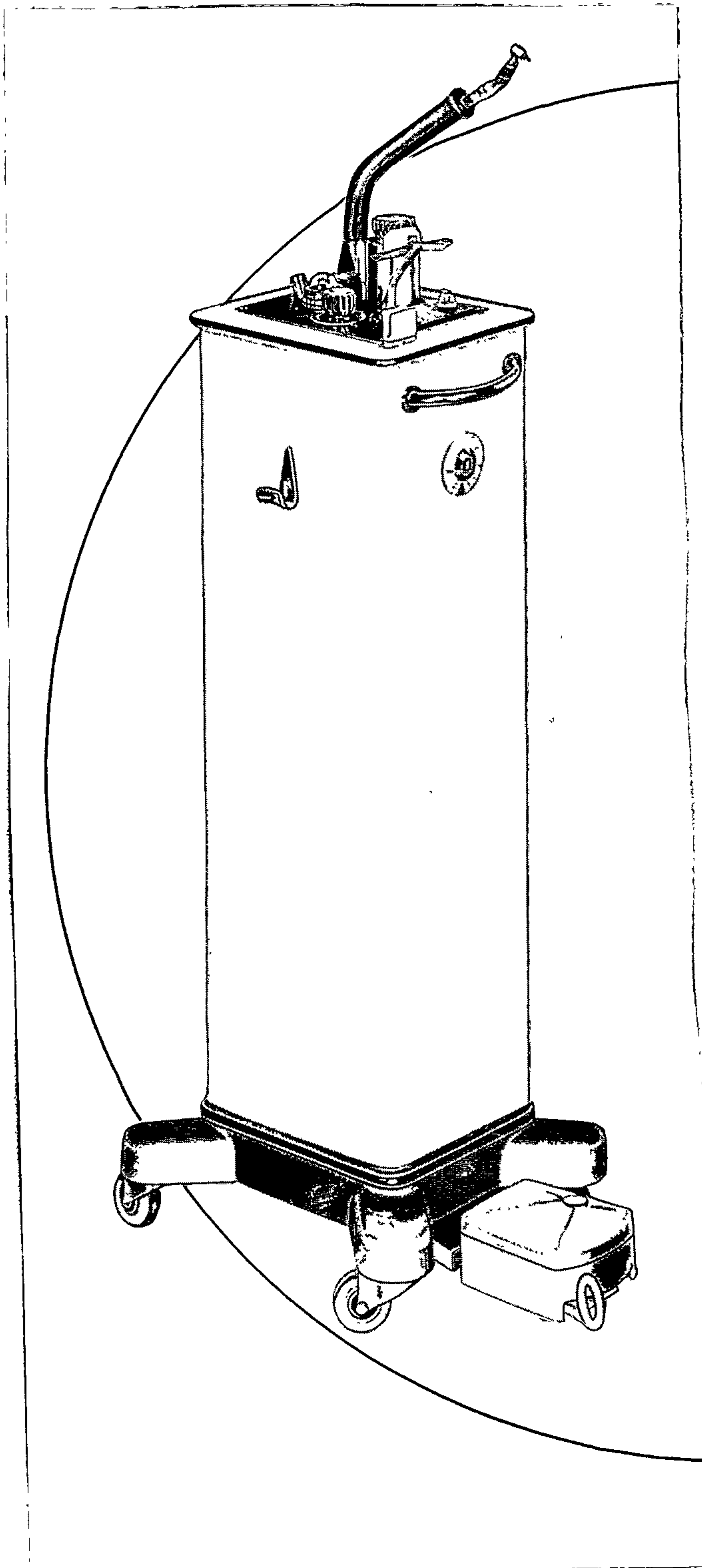


Figure 20.

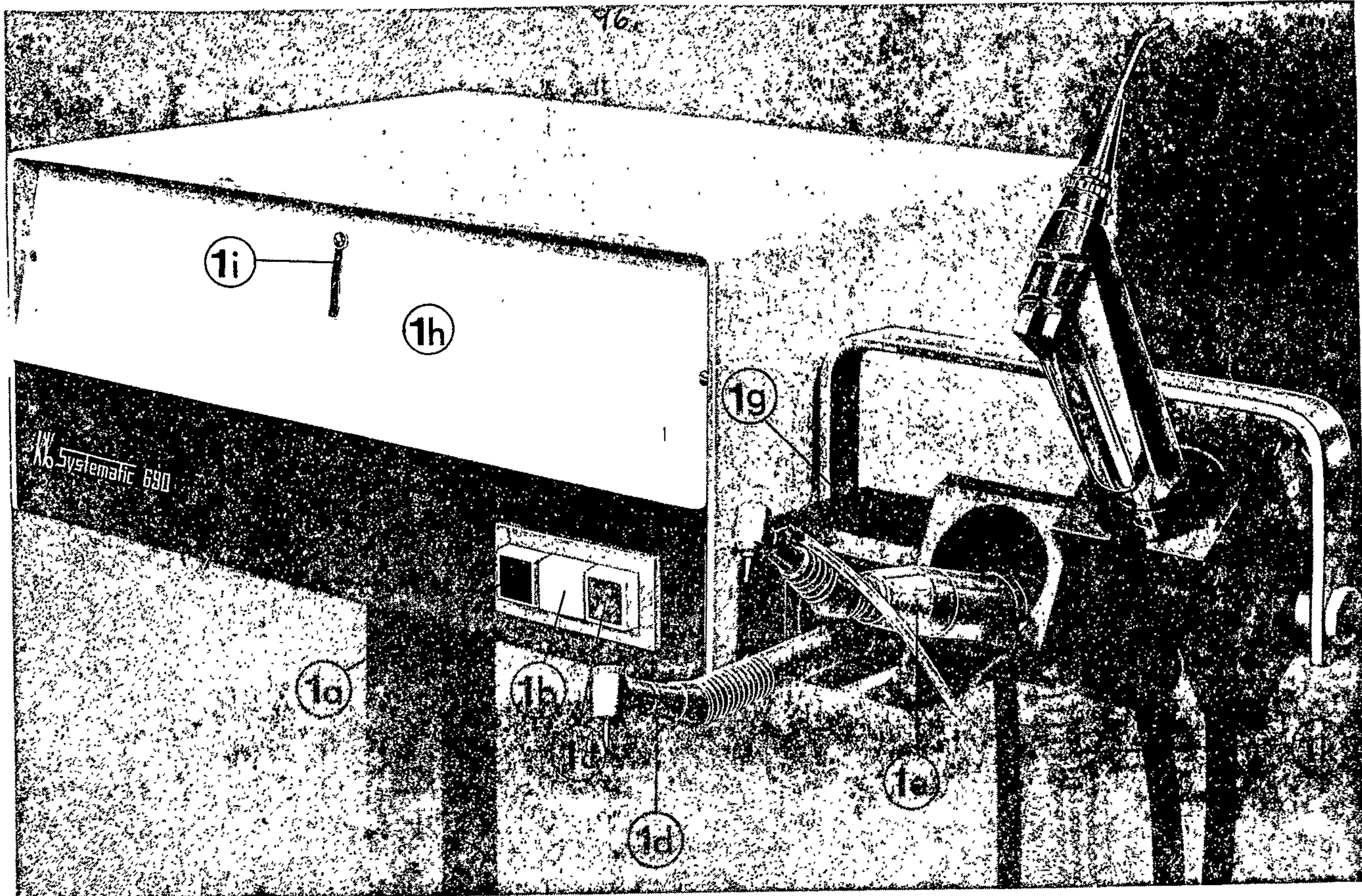
*Figure 24.*

ii) Portable boxes

These are units that can be mounted on a trolley or disassembled and placed as a box unit where required. An example of this is the KAVO Systematic 690 shown in Figure 26 and Vol.2, Plate 48. With portable equipment there is a requirement for ease of access to the working parts for servicing. This is shown in Figure 27.

iii) Units in carrying cases - the "surgery in a suitcase" type. These consist of a refillable CO₂ container, refillable water container and variable speed foot-control, and are completely portable. They are ideally suited to home-visits, ward use etc. Figures 28, 29, 30, 31 give examples of these. Also Vol.2, Plates 31, 32 shows the Beldent, which comes in two suitcases, one of these the operating unit and the second the support unit.

Also the "Porta-Cart" (Figure 32) combines both the trolley situation and can also be carried in a suitcase.



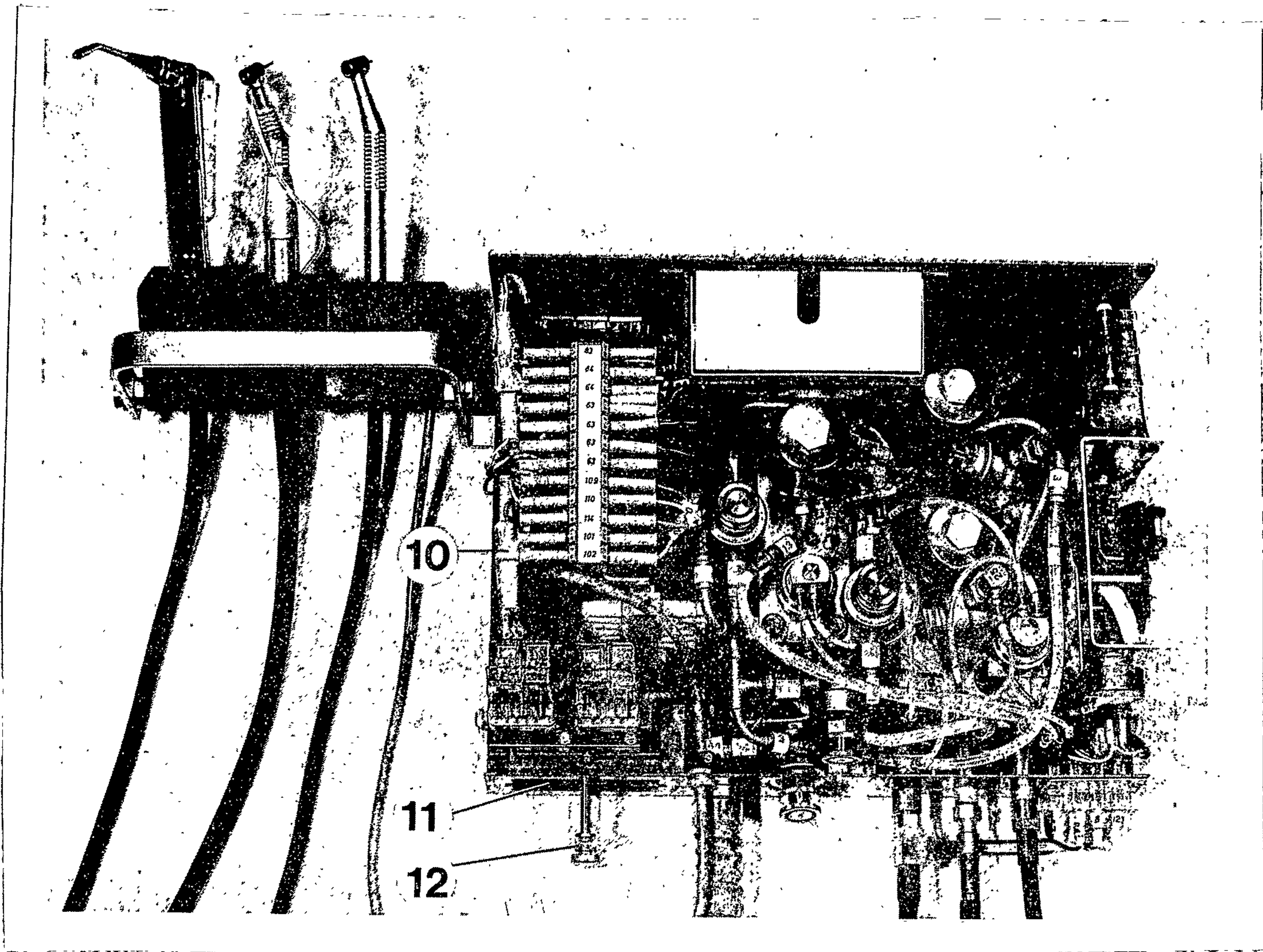
PART B: OPERATION

1. Explanation of unit functions =====

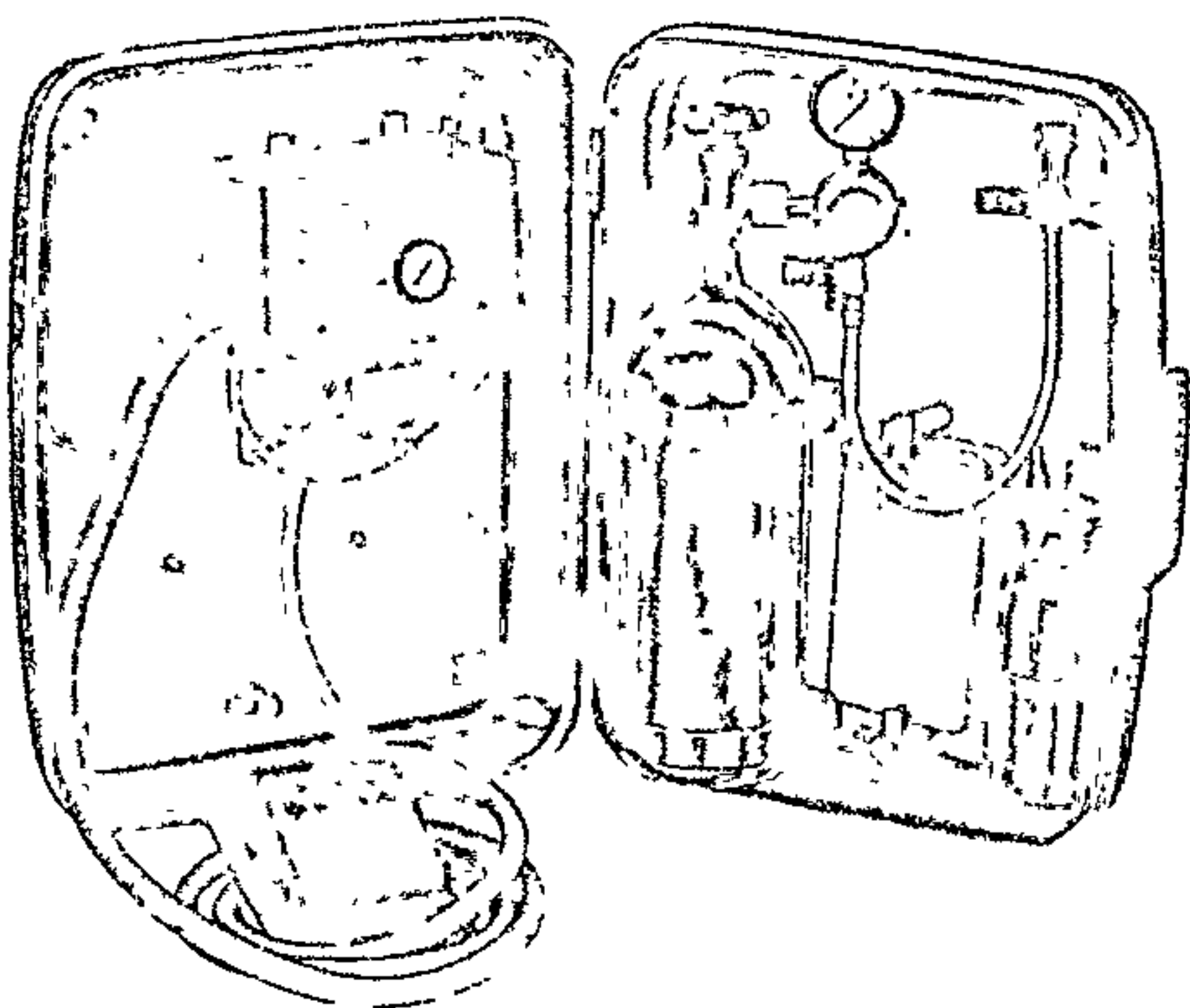
- 1 a) Master switch with red pilot lamp
- 1 b) Switch for X-ray viewer
- 1 c) Pilot lamp yellow (spray preselection)
- 1 d) Turbine
- 1 e) Sirona motor
- 1 f) 3/1 or 7-functional syringe resp.
- 1 g) Cut-off support turbine (change-over motor/turbine)
- 1 h) X-ray viewer
- 1 i) Clip for X-ray film
- 1 k) Supply tubing

Figure 26.

UNIVERSITY
OF SYDNEY
DENTAL LIBRARY

*Figure 27.*

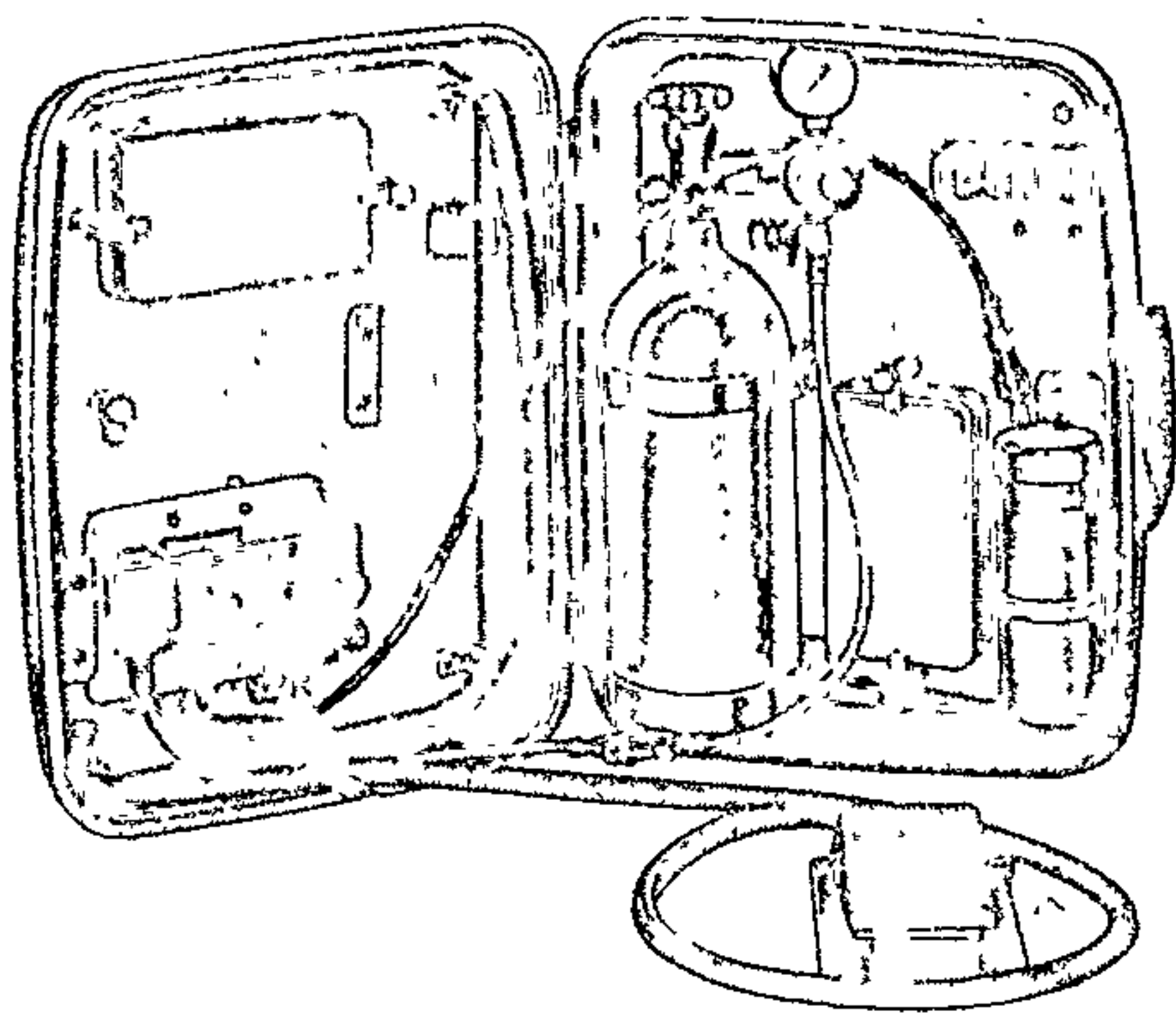
ENCORE PORTABLE UNIT TD-316-A • • Incorporates the complete DC-418 Vari-Trol concept.



FEATURES:

- 1 — Refillable CO₂ container.
- 2 — Refillable water container.
- 3 — Instrument holders.
- 4 — Storage container.
- 5 — Unit may be completely sterilized.
- 6 — Variable speed foot control.
- 7 — Operates any three lubricated and/or non-lubricated air-driven handpieces.
- 8 — Weight 43 lbs.
- 9 — Handpieces and H.P. tubings **NOT** included.

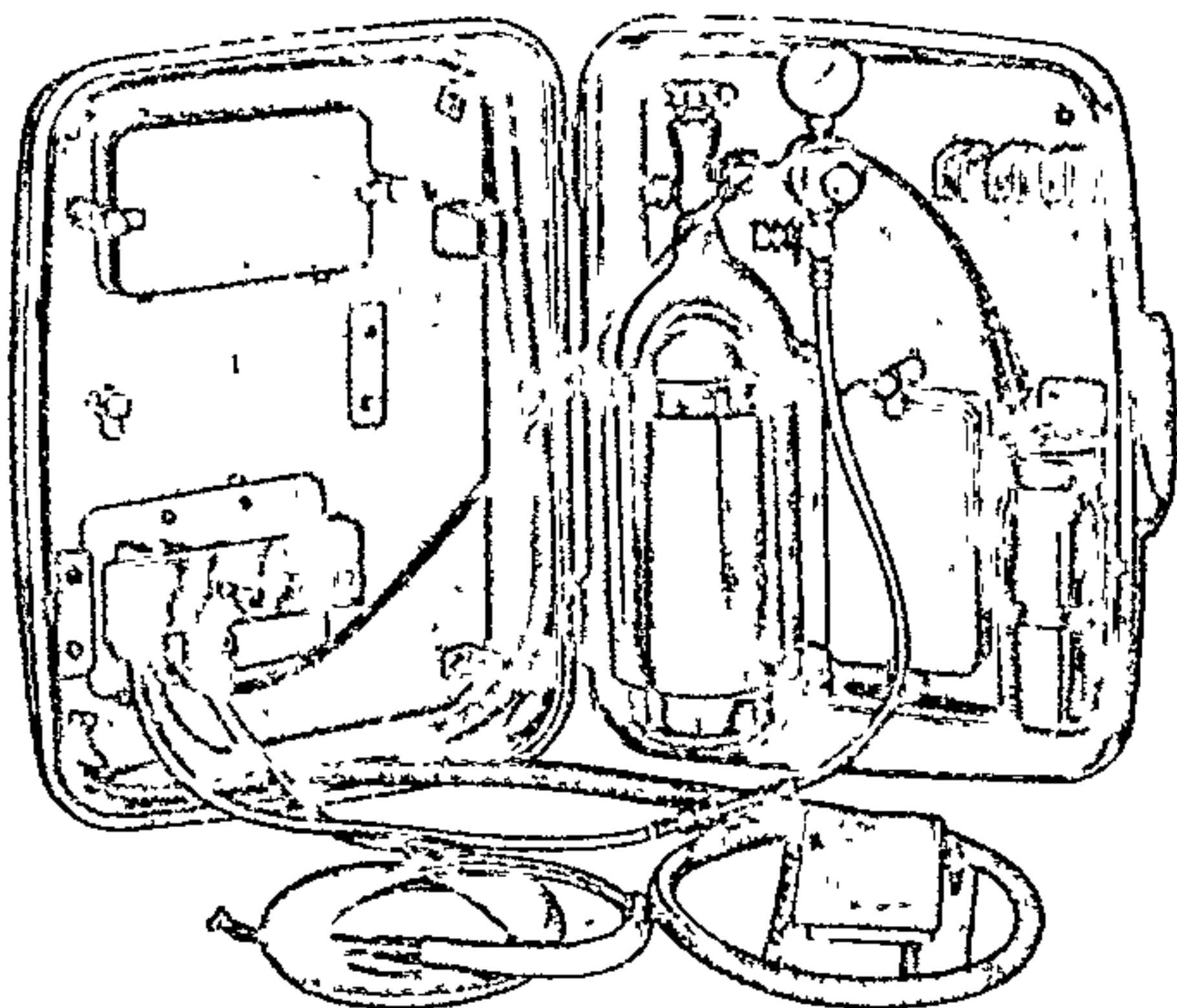
ENCORE PORTABLE UNIT TD-316-B • • Incorporates the complete Vari-Trol concept in miniature form.



FEATURES:

- 1 — Refillable CO₂ container.
- 2 — Refillable water container.
- 3 — Instrument holders.
- 4 — Storage containers.
- 5 — Unit may be completely sterilized.
- 6 — Variable speed foot control.
- 7 — Operates any three **non-lubricated** air-driven handpieces.
- 8 — Weight 40 lbs.
- 9 — Handpieces and H.P. tubings **NOT** included.
- 10 — The Encore E-515 Multi-Function Syringe may be added to the TD-316-B unit at additional cost.

ENCORE PORTABLE UNIT TD-316-C • • Designed to use the WM-403 Air Orbit Handpiece exclusively.

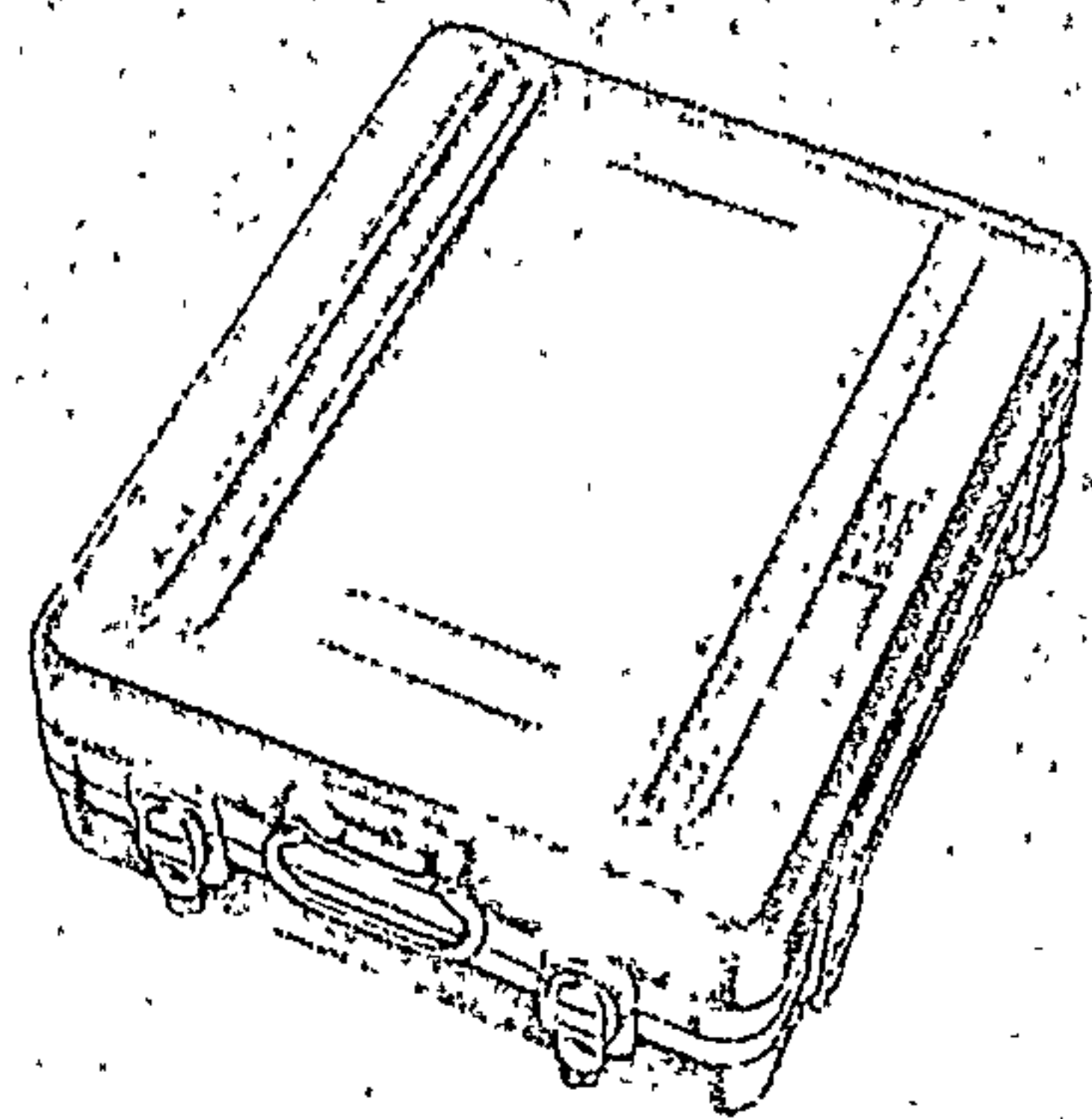


FEATURES:

- 1 — Refillable CO₂ container.
- 2 — Refillable water container.
- 3 — Instrument holders.
- 4 — Storage containers.
- 5 — Unit may be completely sterilized.
- 6 — Variable speed foot control.
- 7 — For use with one **WM-403** Handpiece.
- 8 — Weight 38 lbs.
- 9 — WM-403 Air Orbit Handpiece **IS** included.
- 10 — The Encore E-515 Multi-Function Syringe may be added to the TD-316-C at additional cost.

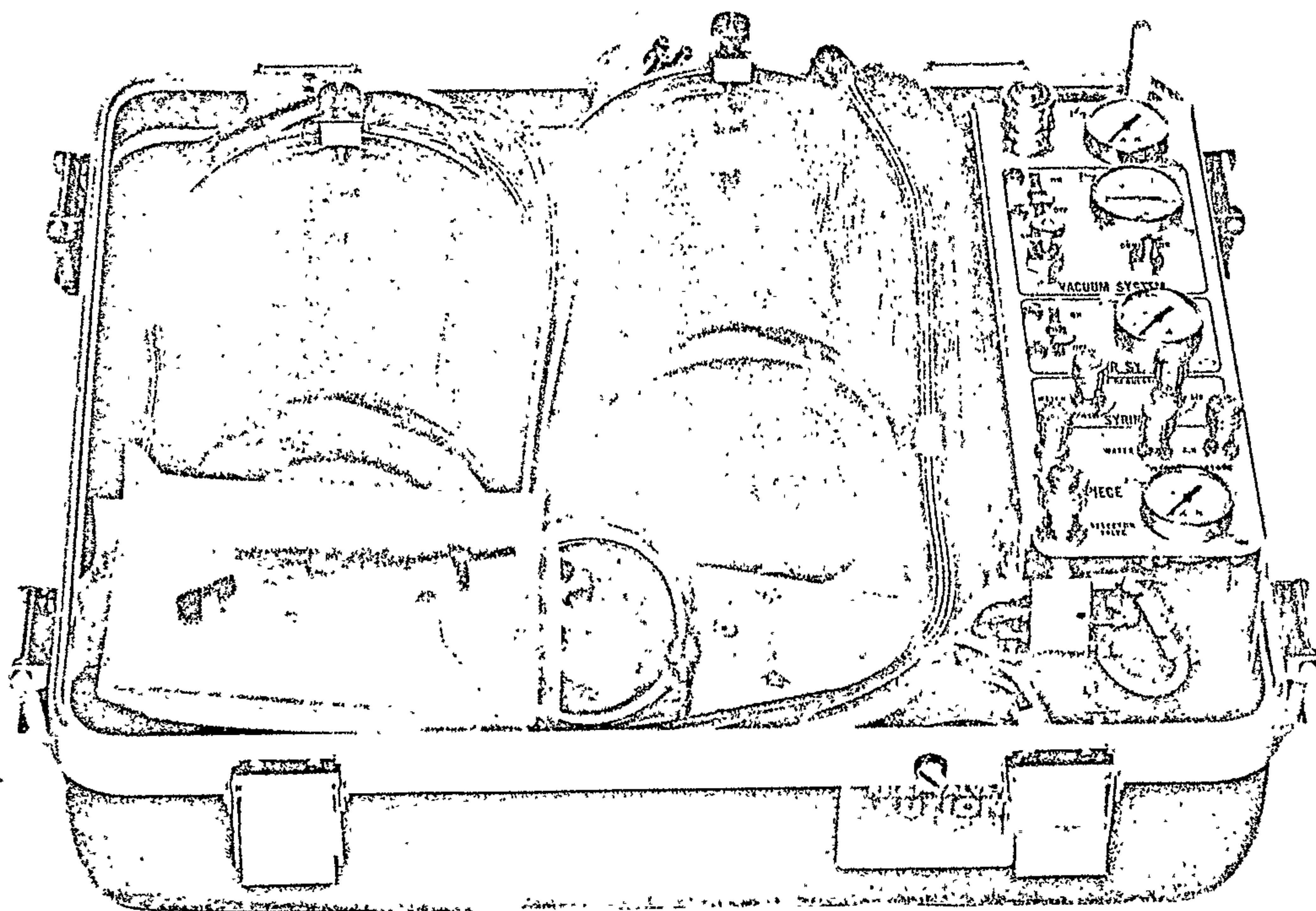
Figure 28.

self-contained operating unit



unit ready for shipment

This is a self-contained operating unit, providing the dentist with sufficient equipment to perform required operative and oral surgical procedures. All equipment in the operative console is designed to operate without dependence upon an electrical power source. Air pressure may be supplied either from a companion E-519-C compressor unit or from other air sources.



unit packed into case

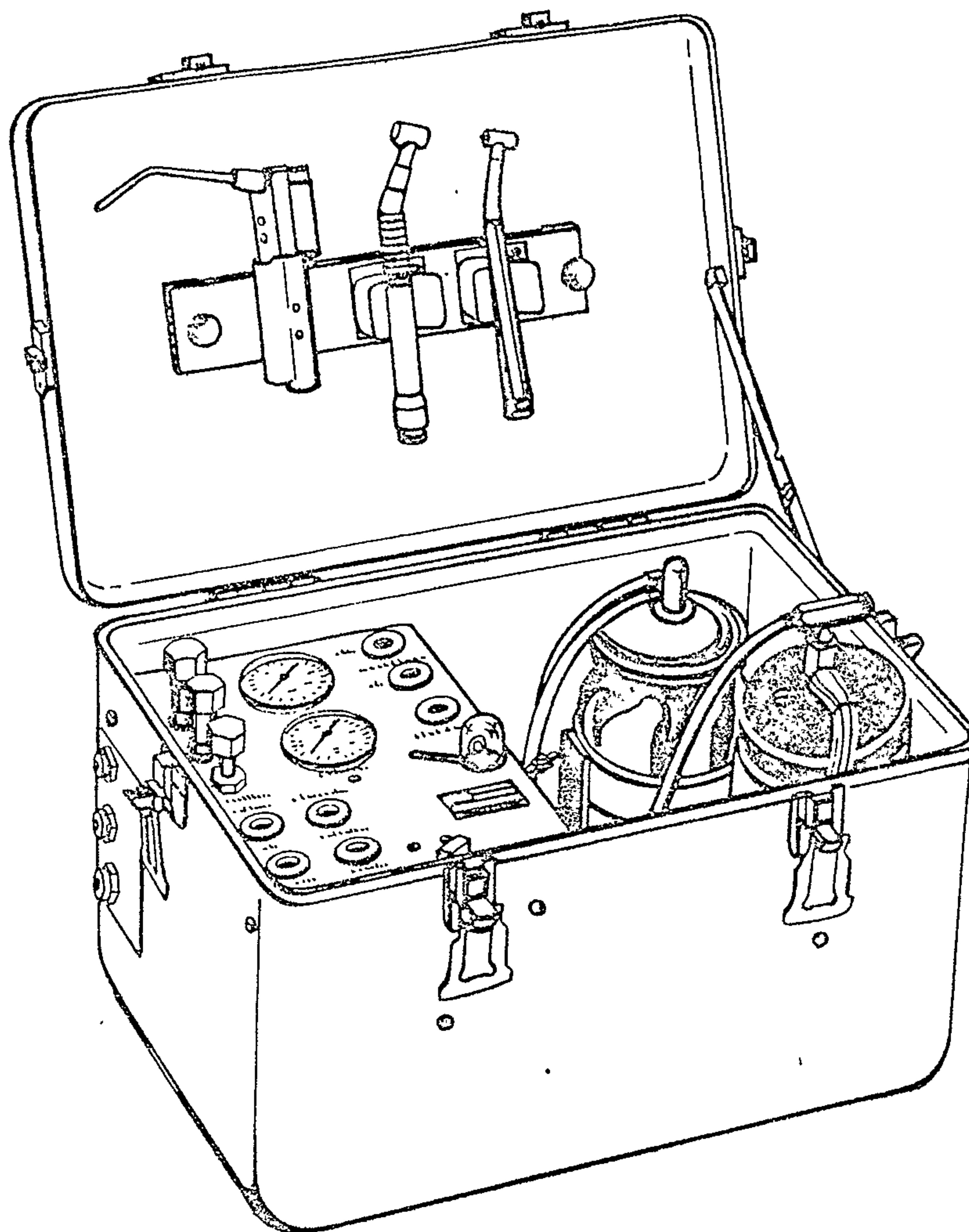
features:

- One Encore handpiece (contra-angle) with accessories, including spare chucks, bur removal tool, chuck removal tool, and handpiece cleaner. (Straight handpiece shown is not included.)
- Syringe for air, water, or spray.
- Evacuator syringe and tip.
- Vacuum cuspidor with water flush.
- Vacuum system and effluent collector.
- Water supply tank.
- Handpiece selector valve (three non-lubricated handpiece selections).
- Control unit for the air-driven instruments.
- Controls and connections for components in the operative console.
- Tray, stand, and instrument holder.

PORTABLE AIR DRIVEN DENTAL UNIT

PORT-A-DENT[®]

A completely portable air driven dental unit.



• **Versatile!** • **Compact!** • **Mobile!**

Densco's all-new Port-A-Dent is the latest portable control box for busy dentists who must work away from their offices.

- Easy to carry! Only 19 lbs. with all furnished equipment.
(No bigger than an overnight bag)
- Sure-grip handle prevents slipping or dropping.
- All furnished equipment rigidly — yet conveniently — stored to prevent damage in transit.
- Soft gray color blends in with all decors.
- No electrical connections are necessary. The Port-A-Dent operates from either a compressed air source or a CO₂ tank (not supplied).

The Port-A-Dent is supplied with Pressurized Water System, Air powered Saliva Ejector, Air - Water Foot Control, Five feet of 2 conductor hose complete with quick connects and #5115 handpiece adaptor, Five feet of 3 conductor hose complete with quick connects and #5145 handpiece adaptor, Ten feet of polyflow air line with quick connect and one ½-ounce bottle of Densco Turbine Oil.

Does not include handpieces, syringe or CO₂ power unit.

Figure 30.

ORDER NUMBER 3241—PRICE \$700.00

BELVAC'S

Beldent System

Portable Dental

Operator

The Beldent System has received a fine reception from members of the dental profession who have had an opportunity to apply this portable dental system to the needs of their particular practices.

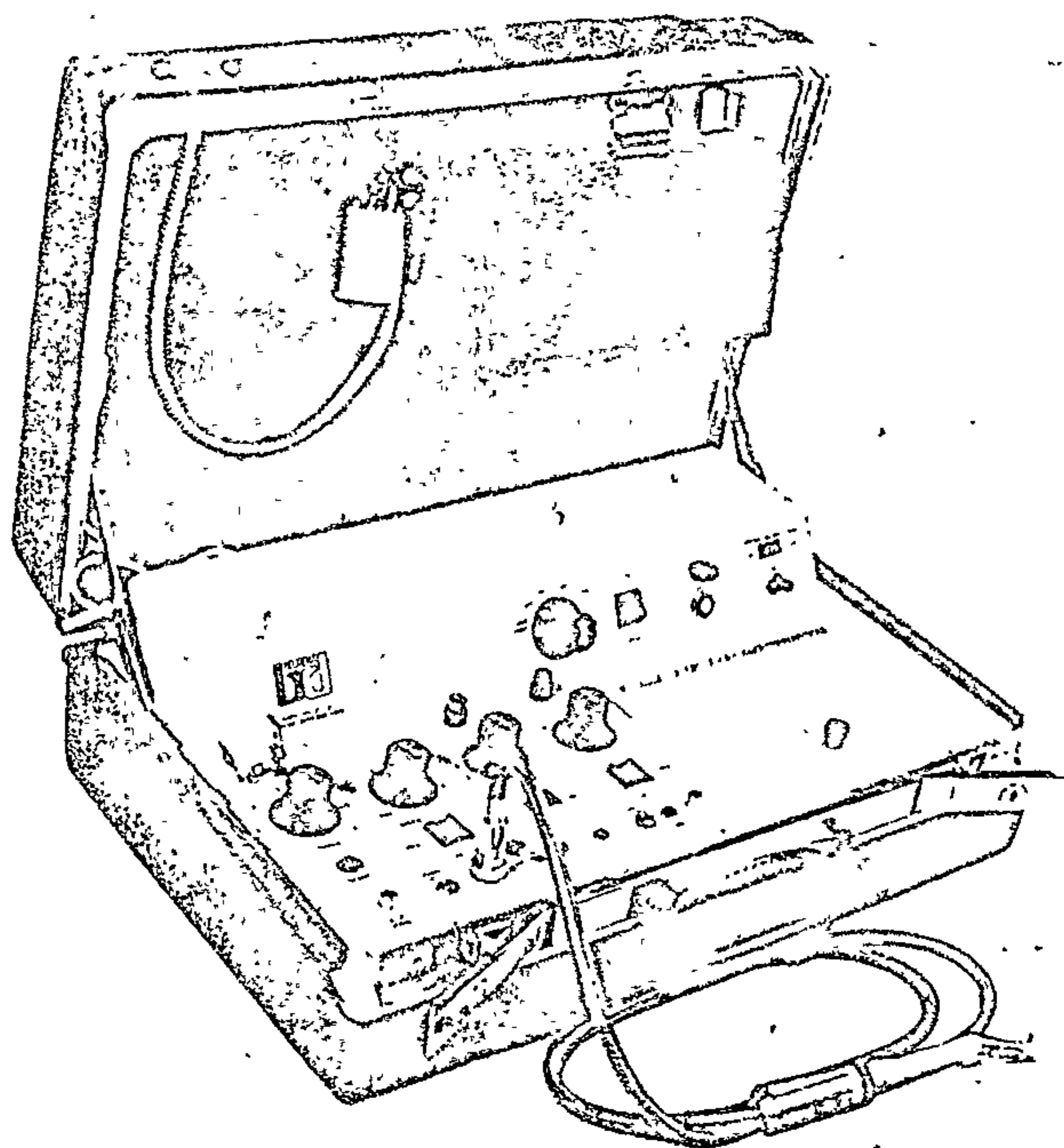
The basic 28-pound Beldent System—a true "dentist's office in an attache case"—has already shown its practicality in a number of challenging operations in clinics, offices, hospitals and in the field.

The built-in electro-surgery feature of the Beldent is a completely miniaturized, solid state unit which provides the operator with the capability to perform those surgical procedures necessary in the practice of dentistry, as well as operating procedures required under certain field conditions. The unit's modularized and miniaturized construction eliminates trouble in the field.

BELDENT Portable Operator **Model No. BAC-20**

- Powered by self-contained rechargeable power pack or AC current supply (115 or 230 volts nominal).
- Lightweight motor-driven contra-angle, 20,000 RPM, reversible; with foot control.
- Extra-oral light.
- Intra-oral diagnostic light.
- Amalgamator and electronic timer.
- Electrically heated spatula for wax and gutta percha.
- Power input/recharge cable.
- Input voltage selector switch.
- Multi-position mode switch.
- Contra-angle socket and reversing switch.
- Foot control socket.
- Examining light and intra-oral light sockets.
- Supplementary accessory socket.
- Main charging plug.
- Two circuit breakers.

PRICE: \$1,595.00



BELDENT Portable Operator **with Pulp Tester** **Model No. BAC-20P**

Same as Model BAC-20, plus pulp tester with electrodes.
PRICE: \$1,745.00

BELDENT Portable Operator **with Electro-Surgery** **Model No. BAC-20E**

Same as Model BAC-20, plus electro-surgery unit with two leads and interchangeable tips. **\$1,895.00**

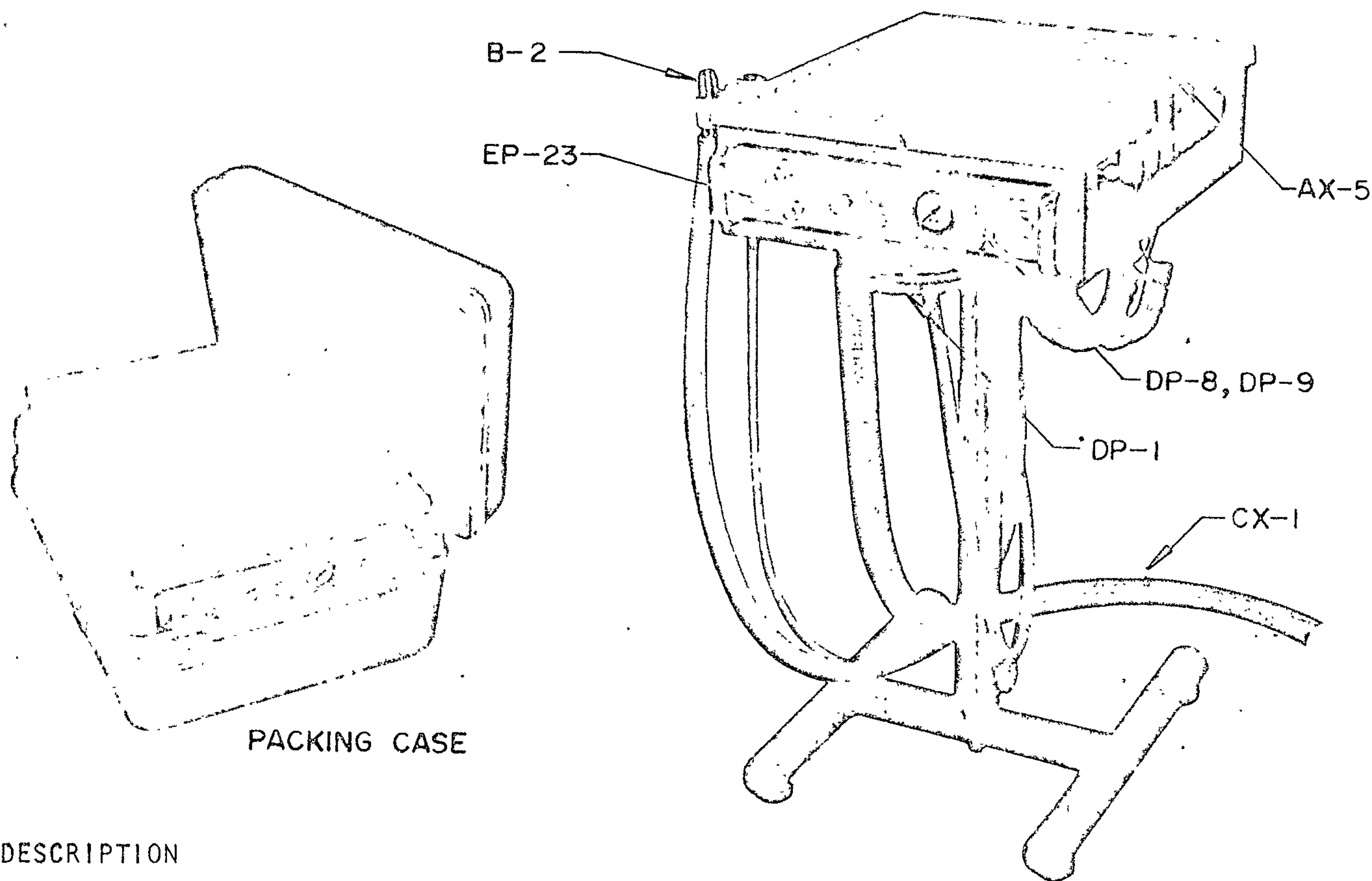
BELDENT Portable Operator **with Pulp Tester and Electro-Surgery** **Model No. BAC-20PE**

Same as Model BAC-20, plus pulp tester with electrodes, and electro-surgery unit with two leads and interchangeable tips. **\$1,995.00**

The overall dimensions of the case when closed are 18" x 12" x 6"

Figure 31.

PORTA-CART PM 105A



DESCRIPTION

The Porta-Cart is a completely self-contained mobile dental unit for field or operator use. This air-operated control offers manual selection of two handpieces with air and water coolant.

A 28-oz. water tank supplies water for the Tri-Flo II Syringe AX-5 and handpiece coolant. The only connection to the unit is an air line which may be attached to an air compressor or a CO₂ tank.

The oral evacuator is an AVS B-2 which includes one High-Velocity evacuation tubing, one saliva ejector tubing, and a 2 quart waste tank.

Handpiece speed is controlled by variable air pressure from the Foot Control DP-1. Maximum air pressure to the unit is limited to 80 PSI by the Air Filter-Regulator EP-4. Drive air pressure is regulated by Pressure Adjustment Screws 29-100 on the Individual Automatic Control Assemblies 29-230. See DP-6 in instruction manual.

The frame is light weight and is easily disassembled for packing in a field case. Disassembly instructions are found in the Porta-Cart lid and in the packing case. Both casters and glides are included with the frame assembly.

The working surface may be adjusted from 24 to 33 inches in height. Any good detergent may be used for cleaning the cart.

Figure 32.

X-Rays: Machines. X-Ray machines have become progressively smaller so that now they can be considered portable and taken into the field situation. Vol.2, Plates 49,50,51 shows a Philips "Oralix" in "broken-down" condition ready for packing. There are several makes of X-Ray of this type that are suitable. Figures 33,34, show the "Oralix" with regard to specifications.

Figures 35,36, show the "Norelco - Oralix super 50", field model with packing case and removable arm.

ii) Processing. The X-Ray "dark room" is virtually a thing of the past. Automatic processing machines for continuous processing of dental films have replaced it. Vol.2, Plate 71 shows this type of machine in use in the R.A.A.F's mobile dental clinic. Figure 37 gives details of the Philips "Universal Clarimat".

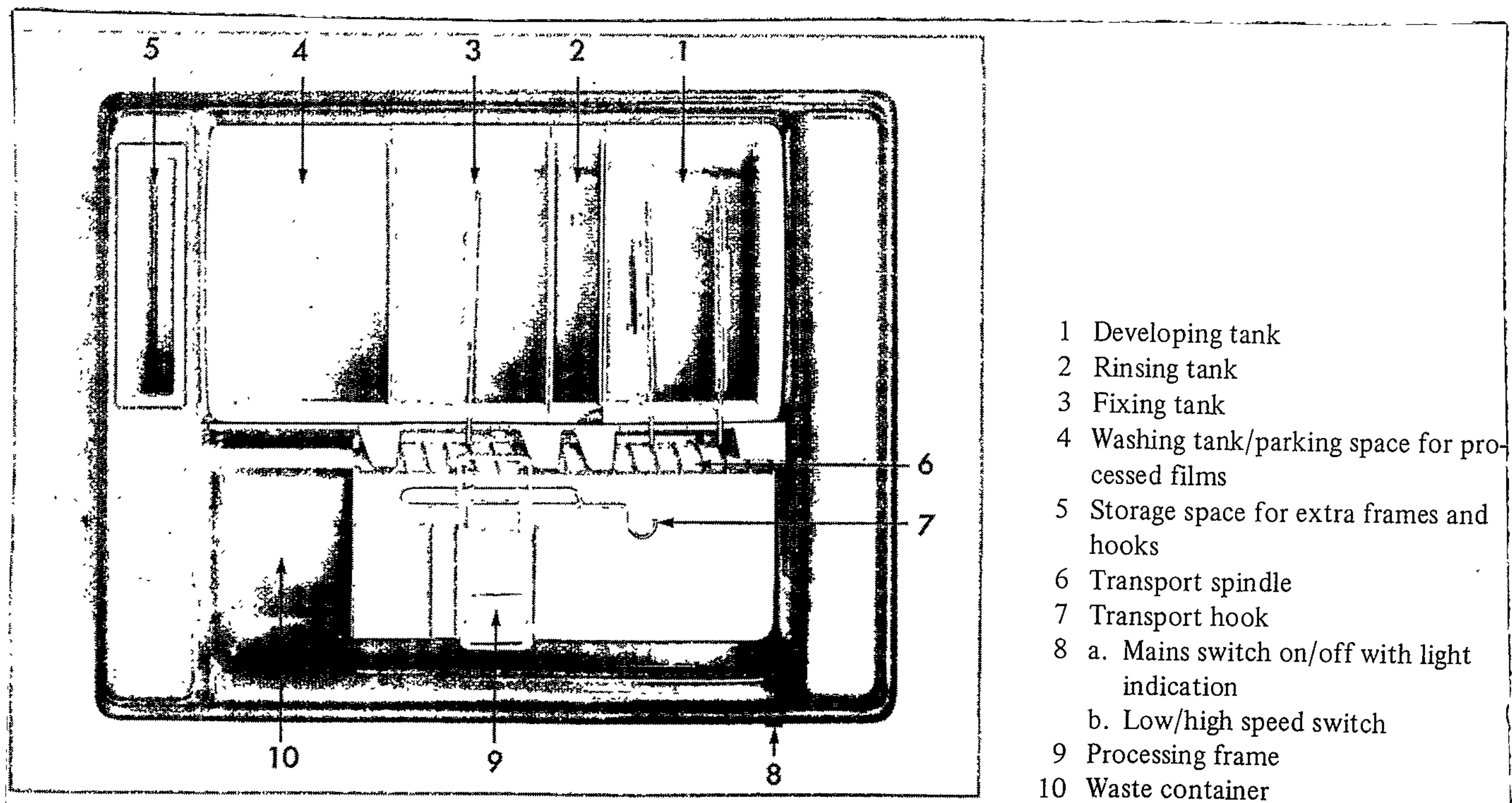
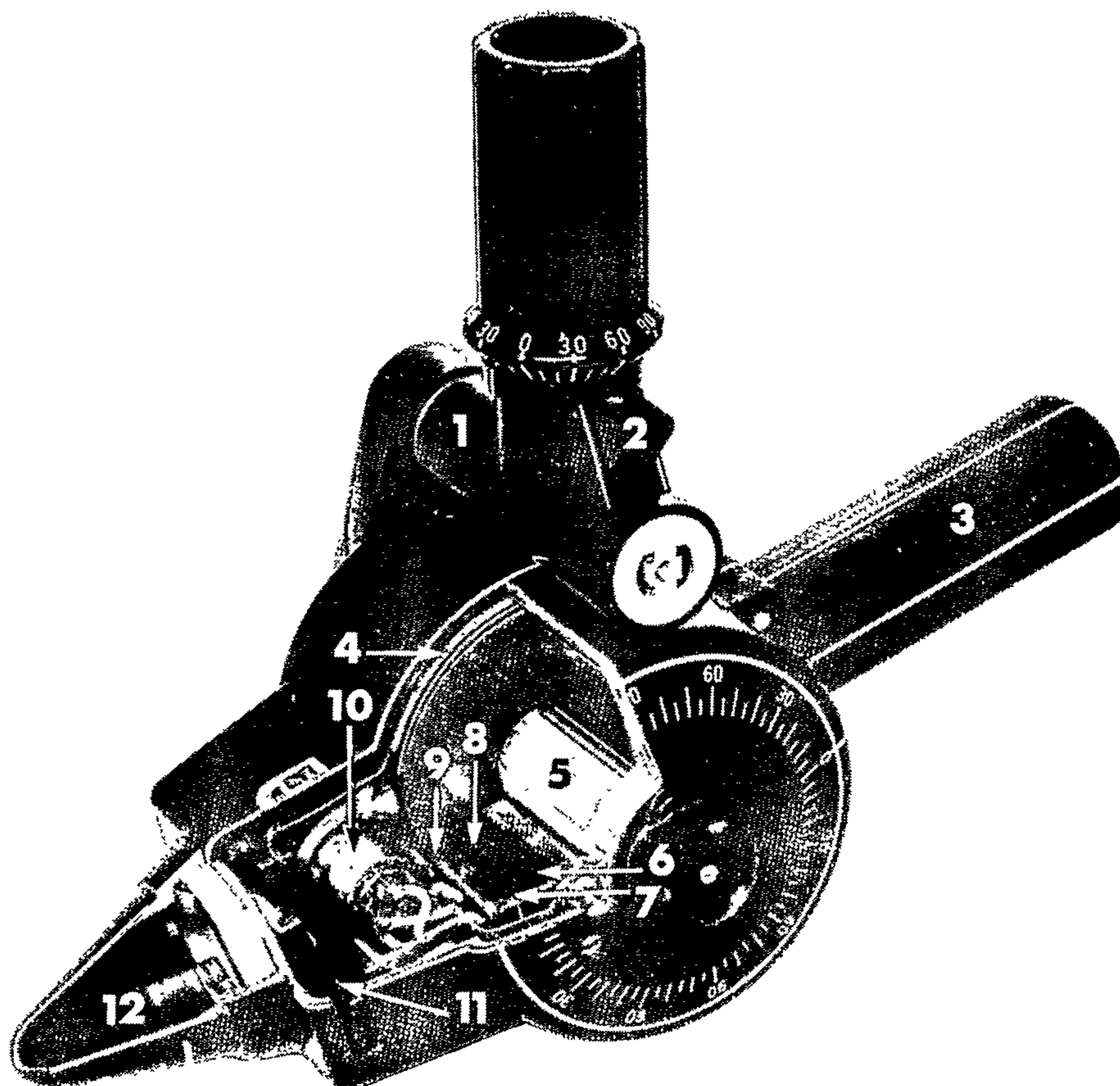


Figure 37.

iii) Self Processing films: Vol.2, Plate 52 shows a Philips film, Phil-X30 that contains its own developer and fixer at the end of an umbilical tube. After exposing the film the green tab is pulled slowly and the solution is helped down the umbilical tube. After 30 seconds the red tab is pulled, waiting a further 30 seconds for the fixing of the film.

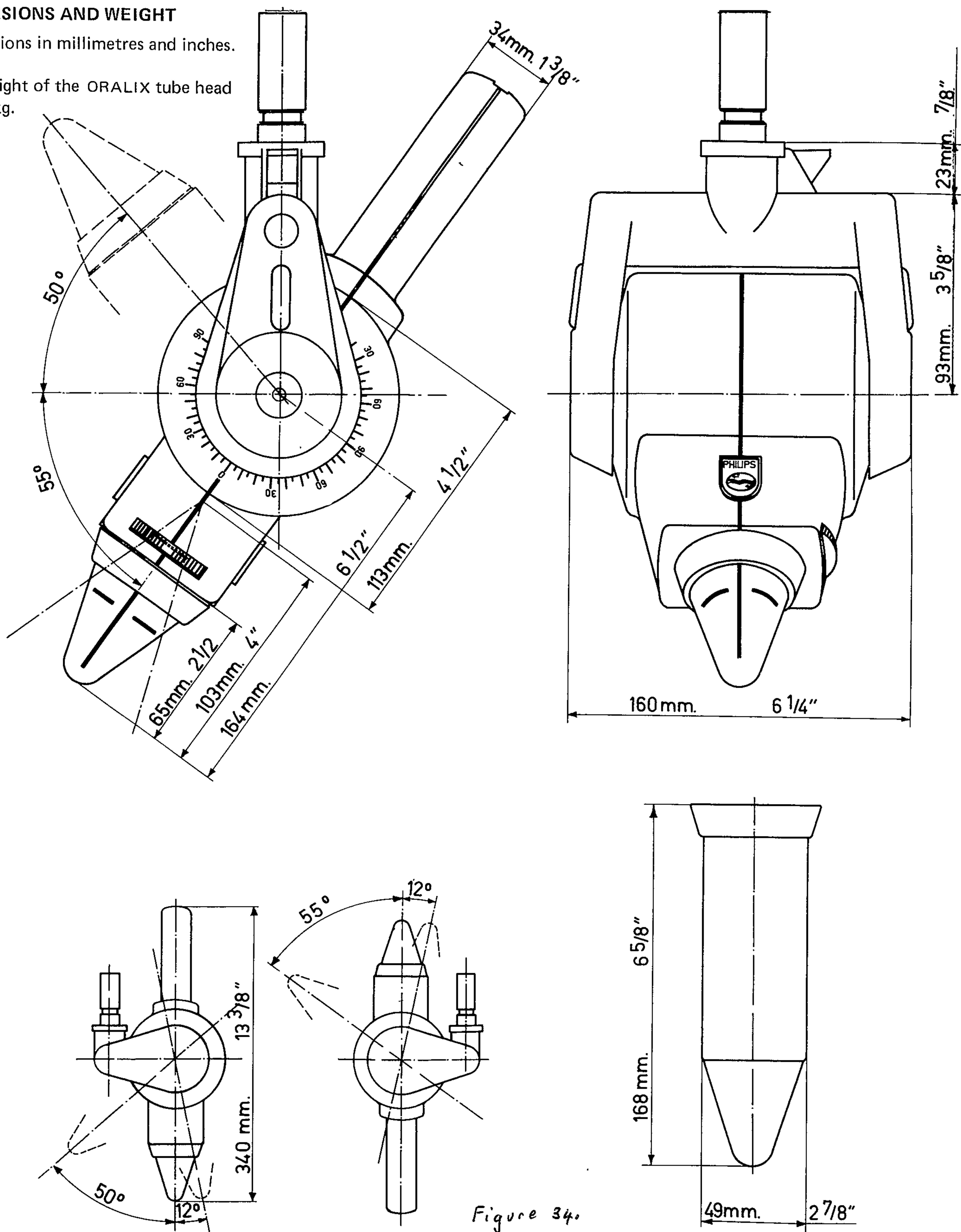
These may have a place in the field for single films in an emergency.

LEGEND



- 1 Trunnion for 90° tilt, in both directions
- 2 Spring loaded pawl release, for rotation
- 3 Positioning handle, containing oil expansion bellow
- 4 Oil-tight, radiation protective container
- 5 H.T. transformer, iron core
- 6 Primary coil
- 7 H.T. coil
- 8 Filament winding
- 9 Grid bias winding
- 10 Three-electrode tube
- 11 Four position turret diaphragm
- 12 Detachable cone

Figure 33.



Norelco[®] ORALIX SUPER 50

TRANSPORTABLE FIELD MODEL 415

(Federal Stock #625-690-3214) (GSA Contract #GS-00S-53267)

INTRODUCING
NEW

PORTABLE
DENTAL

X-RAY
FIELD

UNIT

Especially designed for field use in dental radiography, this transportable X-ray machine is currently used by the Armed Forces, County, State, and U.S. Public Health Services. It is a "traveling version" of the well-known Norelco Oralix Super 50 — over 40,000 of which are performing reliable service in dental offices throughout the world.

Ideal for field use, the Model 415 is the world's smallest and lightest weight portable dental X-ray unit. Ready for use, the 415 can be assembled and disassembled in three to five minutes without tools of any kind. And, the Norelco Oralix supplies superior dental diagnostic information at minimal radiation levels.

The Oralix can be used to advantage in Dental Departments for routine dental radiography; X-ray Departments, for routine extremity radiography; Hospital Wards, for dental and extremity radiography of bedridden patients; Emergency Rooms, for hand, foot, and maxillo-facial injury radiographs.

All components are contained in a drop-tested, water-resistant trunk which serves both as a unit base and for patient seating. Trunk and contents combined weigh only 85 pounds, and can be transported in any standard vehicle.

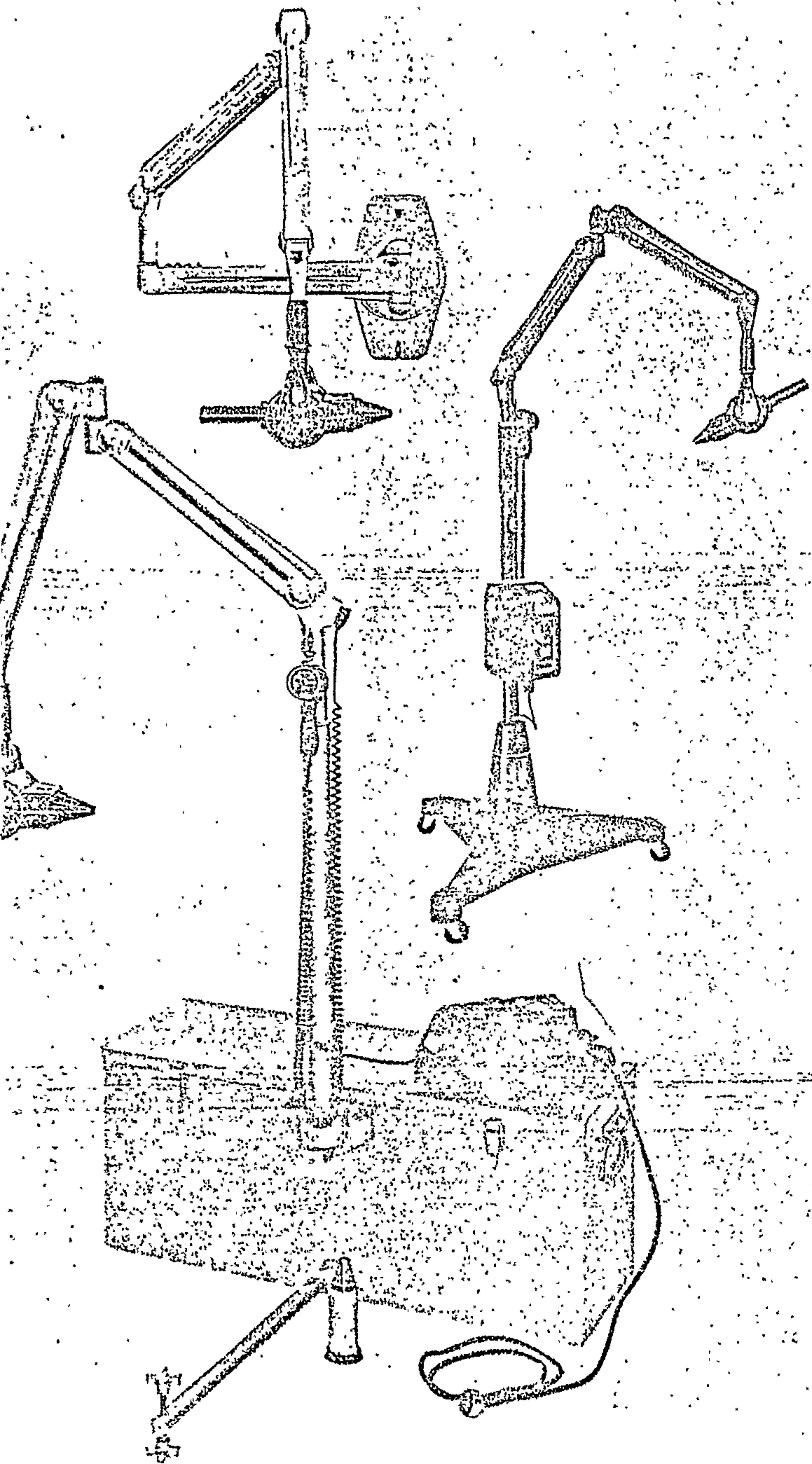
The 415 Oralix features an oil-immersed ray-proof and shock-proof X-ray unit head with a fixed load rating of 50 kV — 7 mA; electronically stabilized grid action X-ray tube with 0.8 mm line focus; and built-in four position field selector diaphragm. Included are short and long cone providing 4" and 8" Focus-skin-distance, folding bracket arm, hand timer, and line voltage compensator.

A unique trunnion assembly allows the tube head to be positioned vertically with cone pointing up or down. This feature is especially valuable when working with age injured, handicapped or wheel-chair patients, since it facilitates occlusal radiography without tilting the patient or the chair.

Figure 35,

Exhibition (C)

Convertible for Field, Operator or Mobile Use



A truly practical design — the Oralix tube head, bracket arm and timer form an assembly which, besides fitting the transportable trunk, is readily interchangeable — fitting onto the optionally available mobile support column or fixed installation wall-mount. Adaptation from one mounting to another is accomplished in minutes without the use of tools. This versatility affords extra economy in the purchase of X-ray equipment, since it satisfies the multiple requirements of many public health programs.

Figure 36

(SPECIFICATIONS)

Model 415 consists of the following:

Manufacturers' Number and Description

- 011227540 — Oralix X-ray tube head, timer, cones
- 030018000 — Bracket arm
- 004133820 — Portable trunk stand with stabilizer legs, adaptor, and vertical support column
- 033417100 — Line voltage compensator

Line voltage 110 volts, 50-60 cycles AC

Line current 7 amperes

X-ray tube high tension 50 kV

X-ray tube current 7 mA $\pm$ 0.5 mA (auto. stabilized)

X-ray tube Grid action, third electrode

X-ray tube head Oil immersed, shielded

Filtration 2 mm Al. Total inherent, composed of glass, Philite and a built-in filter of 1.25 mm Al.

Focal spot 0.8 x 0.8 mm² guaranteed in accordance with American Standard Association, approval No. 83, March 25, 1959

Focus to cone tip distances

Short cone 4 inches

Long cone 8 inches

Focus to front of tube head 45 mm (without cones)

Duty cycle Can produce 6 one-half second radiographs per minute, 360 per hour, over 3,000 in an average 8 hour work day

Ambient temperature

Minimum - 15°C

Maximum + 85°C

Weights

Tube head 10½ lbs.

Bracket arm 19¼ lbs.

Line compensator 12 lbs.

Case assembly only 41½ lbs.

Complete Model 415 85 lbs.

Transit case outside dimensions 35½x12½x15 inches

RADIATION DATA

X-ray output (measured free in air)

At tip of short cone approx. 1.5 r/sec.

At tip of long cone approx. 0.4 r/sec.

Half value layer 1.6 mm Al

Inherent radiation

protection Radiation outside beam less than 7 x 10⁻⁶ r/sec. at 1 meter (I. C. R. P. Recommendation of 1955 allows 0.1 r/hr. or 28 x 10⁻⁶ r/sec. approx.).



**DENTAL
EQUIPMENT**

NORTH AMERICAN PHILIPS COMPANY, INC.
Professional Products Division, 100 East 42nd St., New York, N. Y. 10017

Compressors: There is an increasing need for compressed air in dentistry and to supply this need manufacturers have supplied an increasing range of dental compressors. Bell and Gossett, Sydney, make oil-less, tank-less compressors, that are ideal for a portable situation. Figures 36,37,38 show these compressors. All have carrying handles and dimensions are given. Vol.2, Plate 53 shows a portable compressor with storage tank. These can be separated.

The Den-Tal-Ez/A-Dec Co., make a compact compressor, carried in a case. (Figure 41)

Because of the increasing use of gas cylinders to power dental equipment, Table 14 gives a list of cylinder sizes available from Commonwealth Industrial Gases, Sydney.

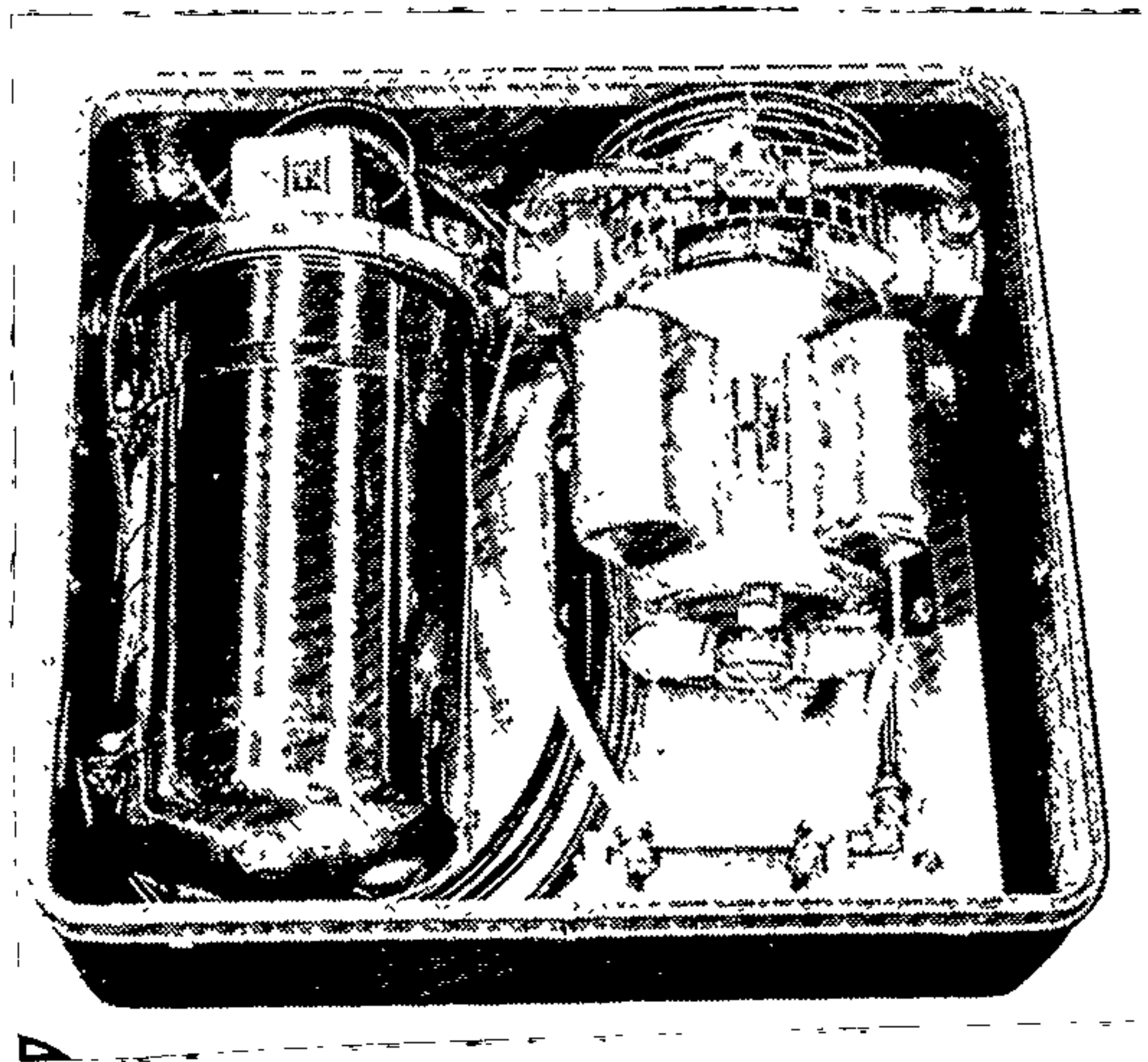
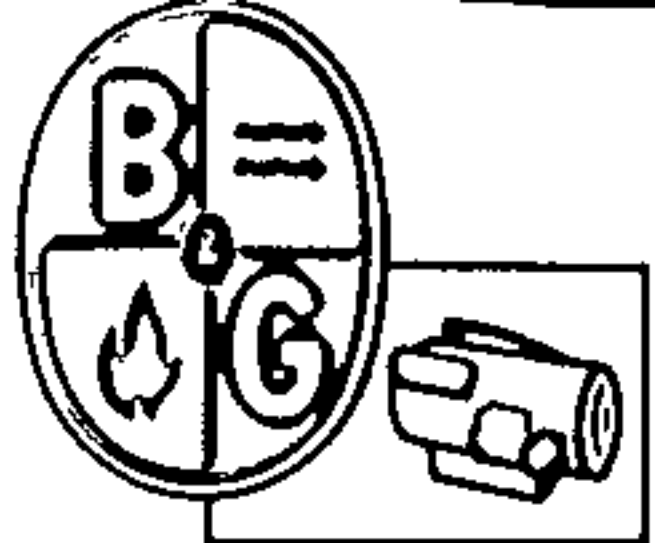
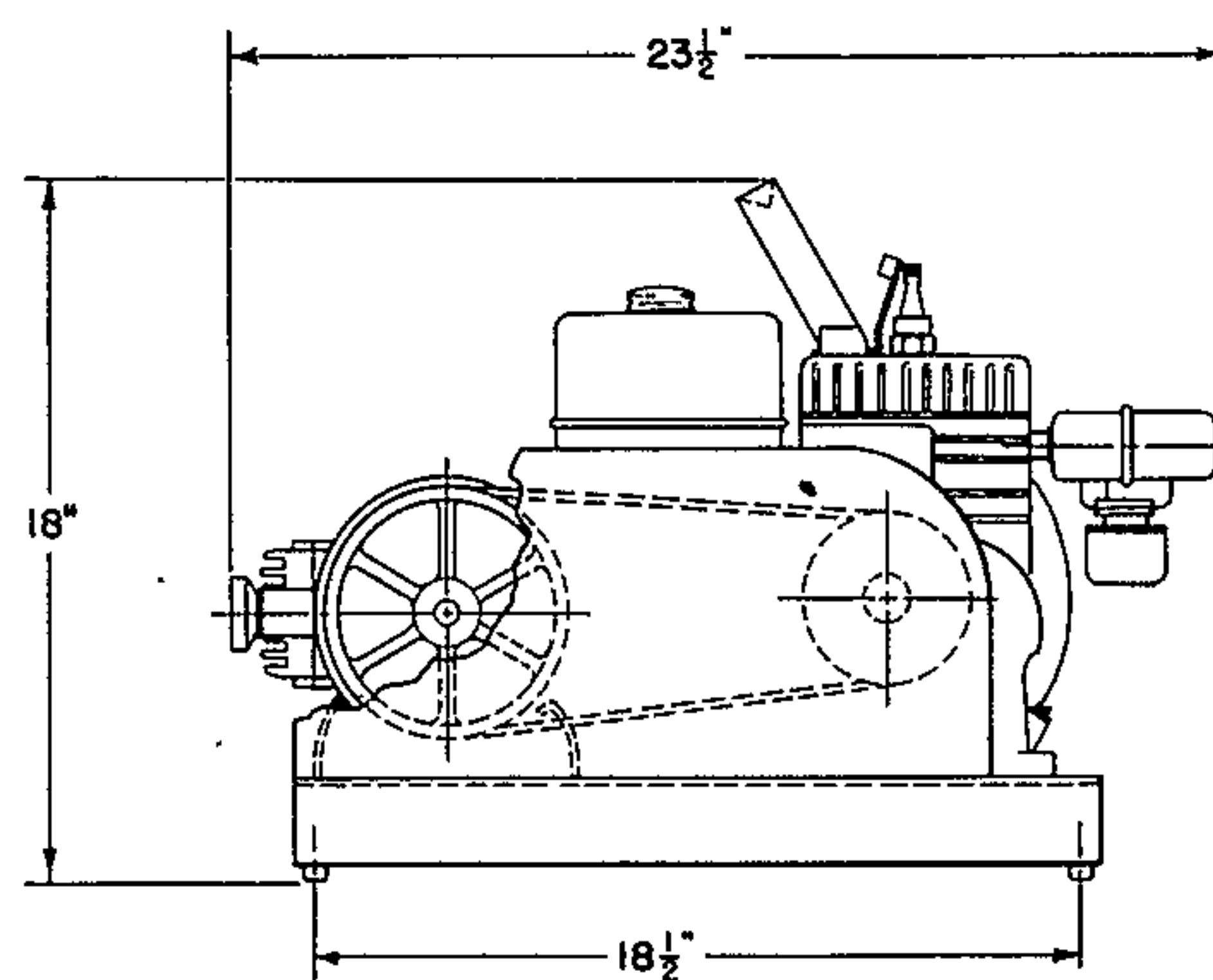
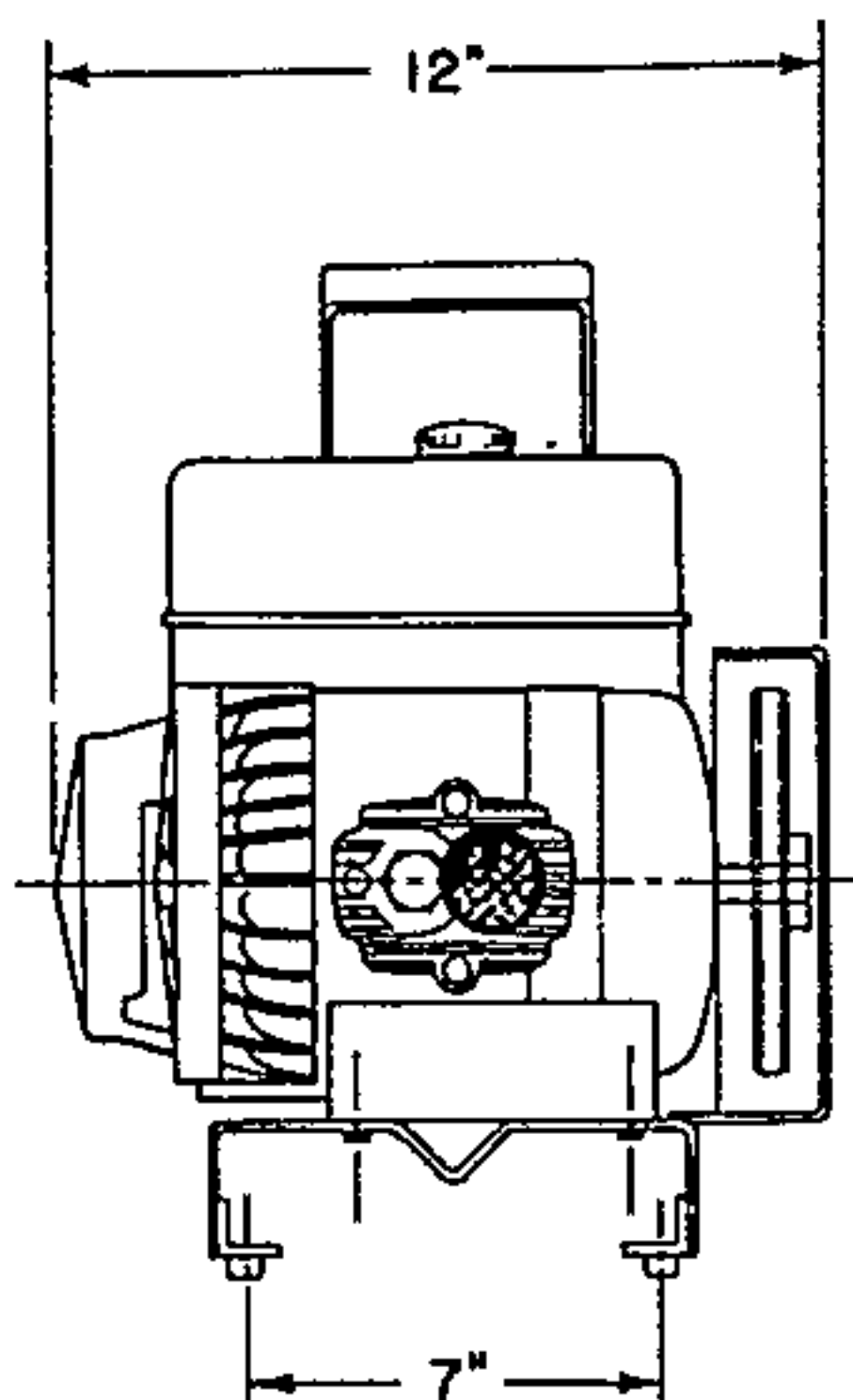
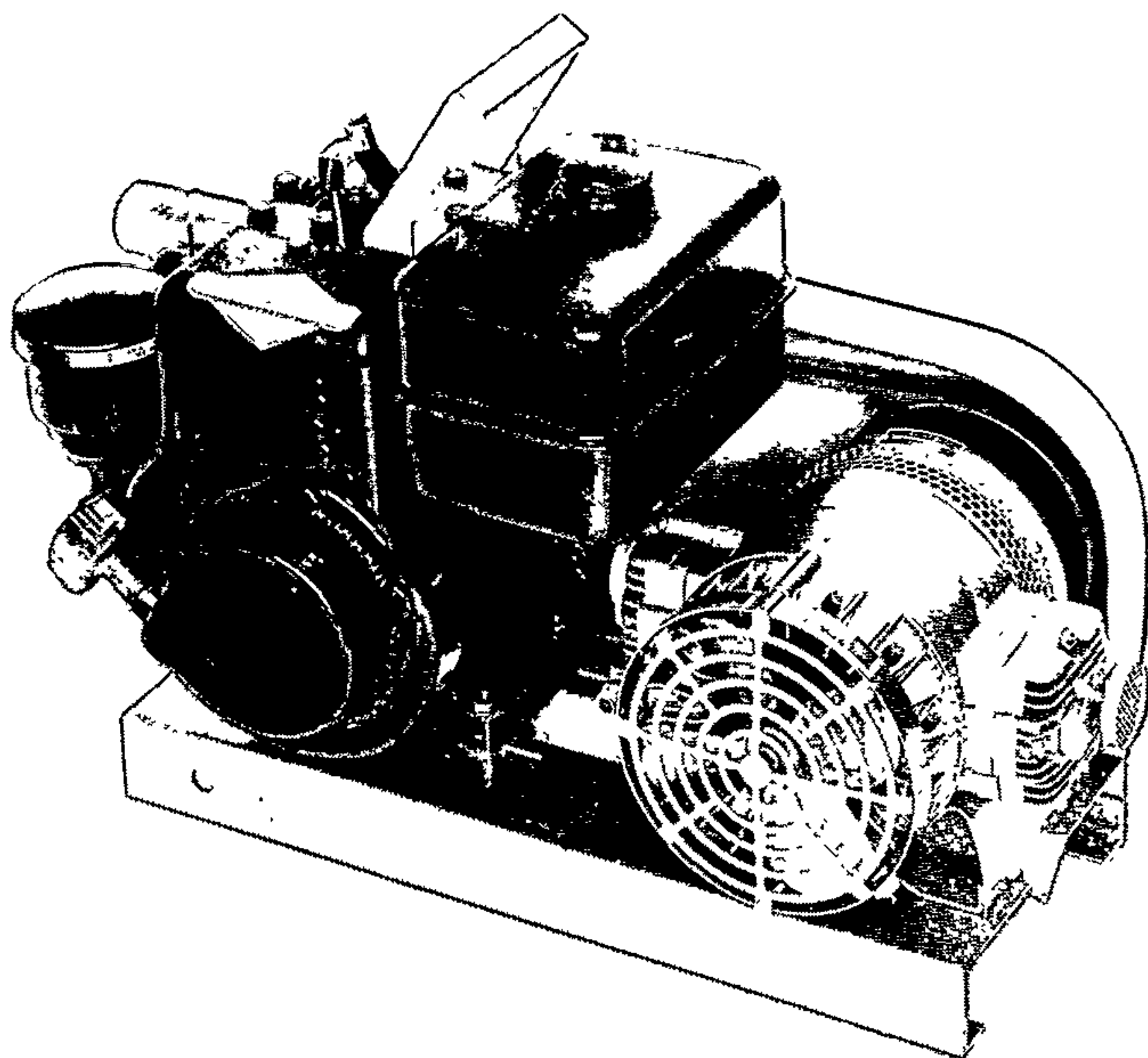


Figure 41.

Compact compressor is single phase one horsepower, oilless, 115-230 volt 50 or 60 cycle energy pack that delivers 4 CFM, 100PSI air power for high speed dentistry. Unsnap case top, plug into portable power source and compressor goes to work.



GASOLINE ENGINE DRIVEN *Oil-less* AIR COMPRESSOR



The B&G gas engine driven compressor outfit delivers Oil Free air up to 90 PSIG continuously. Its lightweight and compact dimensions make it extremely portable. When lifted by the handle, balance is perfect. The belt guard assures safe operation. An accessory kit for wheel mounting, is available.

The outfit includes a belt-driven B&G Oil-less Air Compressor with the same unique features incorporated in B&G motor compressors. The engine is oversized to provide ample power at reduced RPM for longer engine life.

SPECIFICATIONS

MODEL EDCO

B & G OIL-LESS AIR COMPRESSOR

Twin cylinder—single stage—6.57 CFM displacement at 1725 RPM. Integral after-cooler—pulsation chamber—moisture drain. Complete with intake filters and 1/4" NPS discharge connection. Safety valve set to open at 95 PSIG.

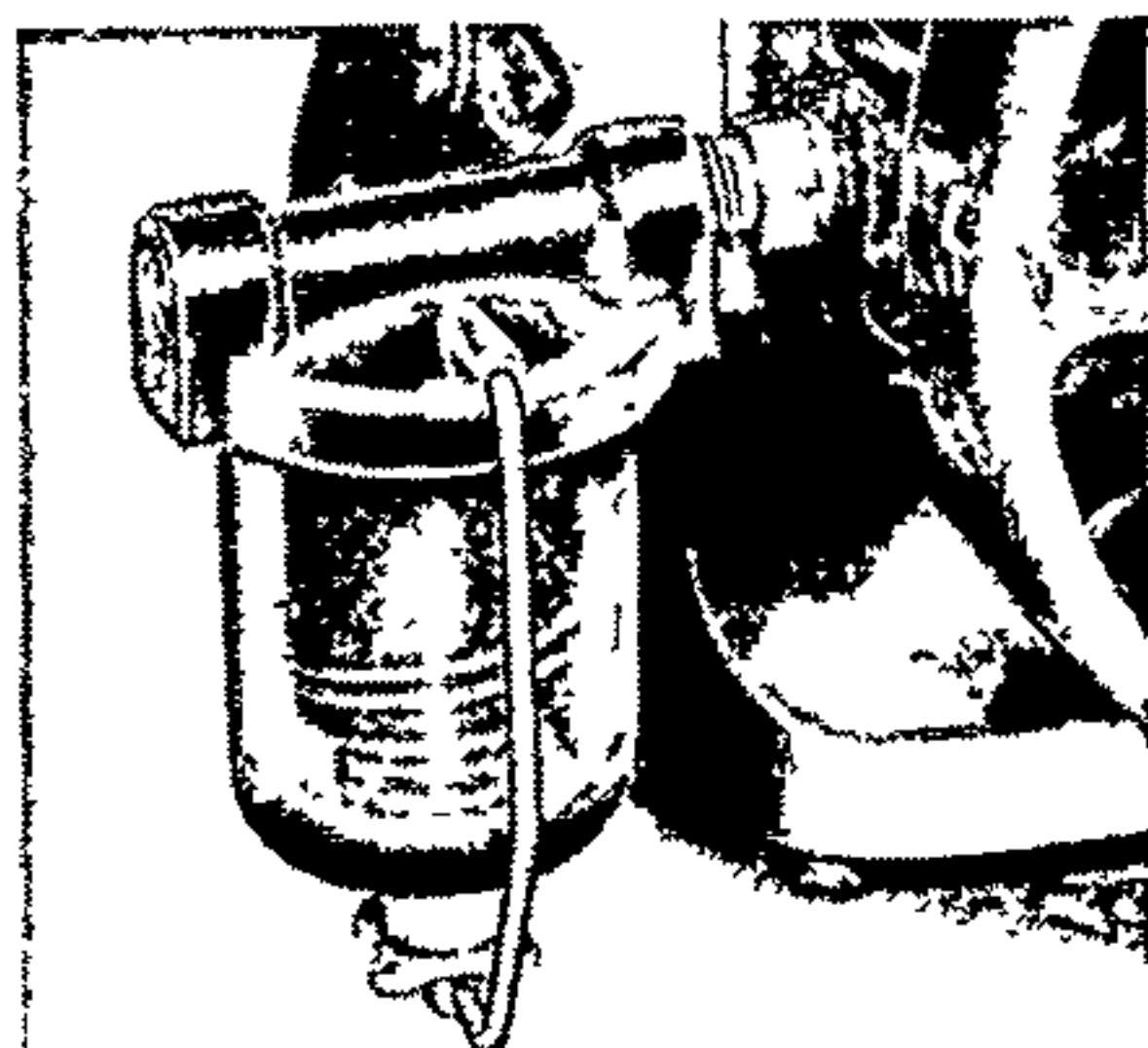
BRIGGS and STRATTON ENGINE

4 cycle, air cooled. 2700 RPM governed speed. Float feed carburetion. 3 quart fuel tank. Recoil starter. Exhaust valve rotator. Oil bath air cleaner.

ACTUAL WEIGHT 56 LBS.

REFER TO PAGE 23 FOR FREE AIR DELIVERY PERFORMANCE

ACCESSORIES



Intake Filter For Vacuum Pumps

Prevents dirt and oil from entering pump when installed on intake fitting. For 1/4, 1/8, 1/2 HP.

Part No. SYC-1338

Intake Filter For Vacuum Pumps

Fits intake bushing and protects LV 1/12 HP. Vacuum Pump from oil and other foreign matter. Filter can be positioned as shown or on either side of cylinder head.

For LV 1/12 HP & BLV 1/6 HP
Part No. SYC 2Z-1338

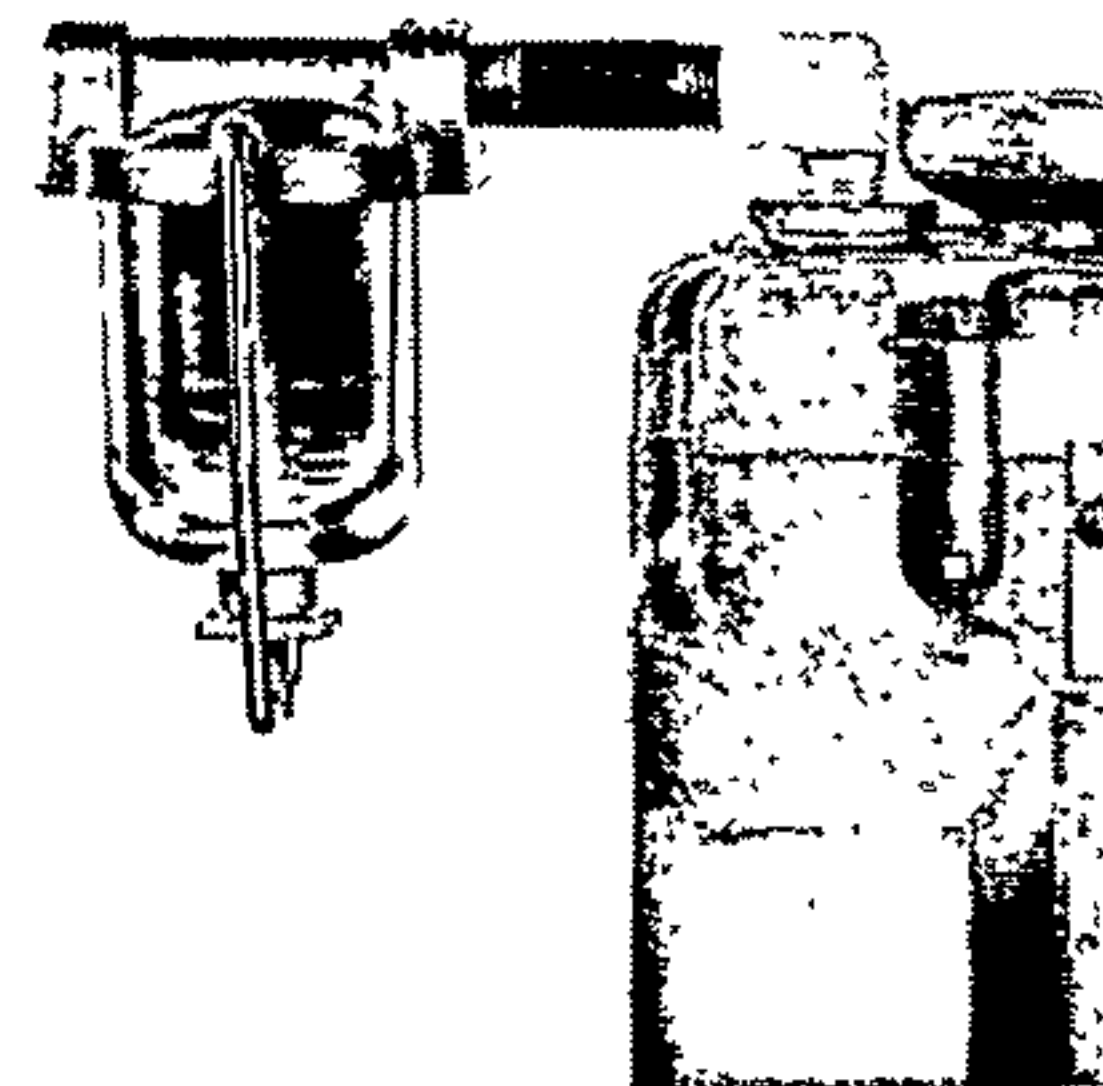
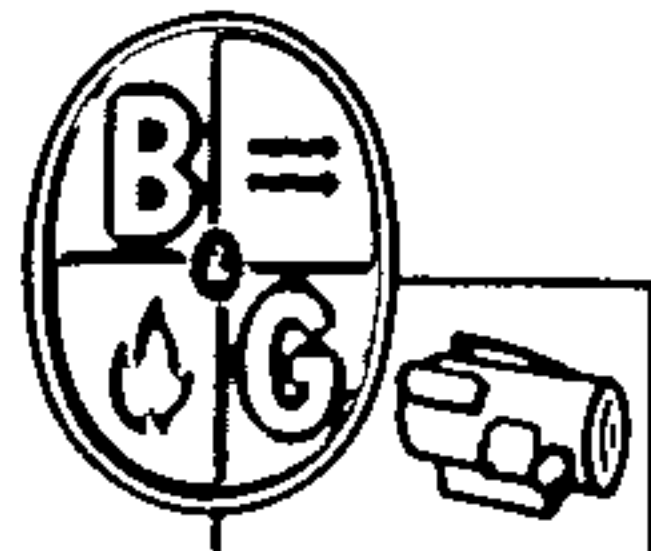
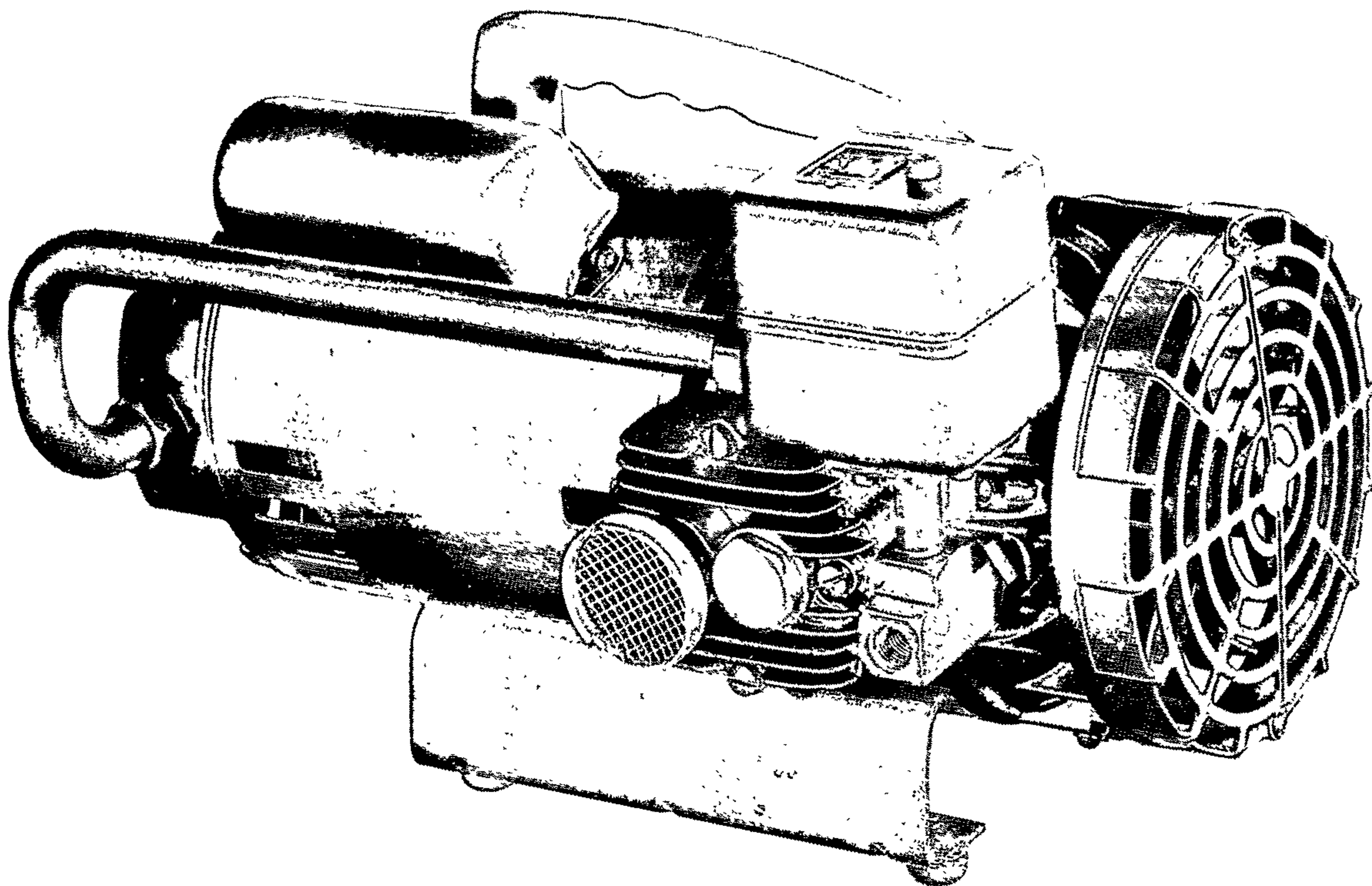


Figure 38.



TANKLESS MOTOR COMPRESSOR OUTFITS



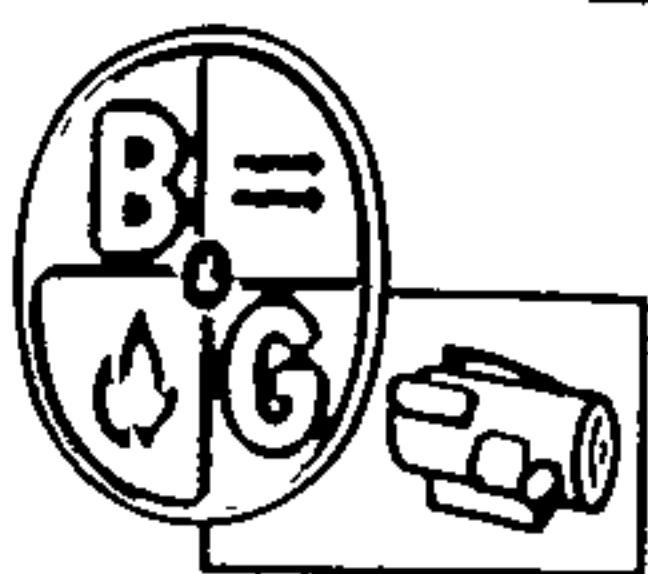
Tankless Motor Compressor Outfits are to be used only where existing air tanks or pipe lines provide sufficient compressed-air storage. Motor Compressors on these outfits are the same as shown on Page 4 and 5 with the following additional equipment: Automatic Pressure Switch, completely wired—Centrifugal Pressure & Moisture Unloader—Check Valve.

REFER TO PAGE 5 FOR MOTOR INFORMATION, PAGE 23 FOR FREE AIR DELIVERY PERFORMANCE

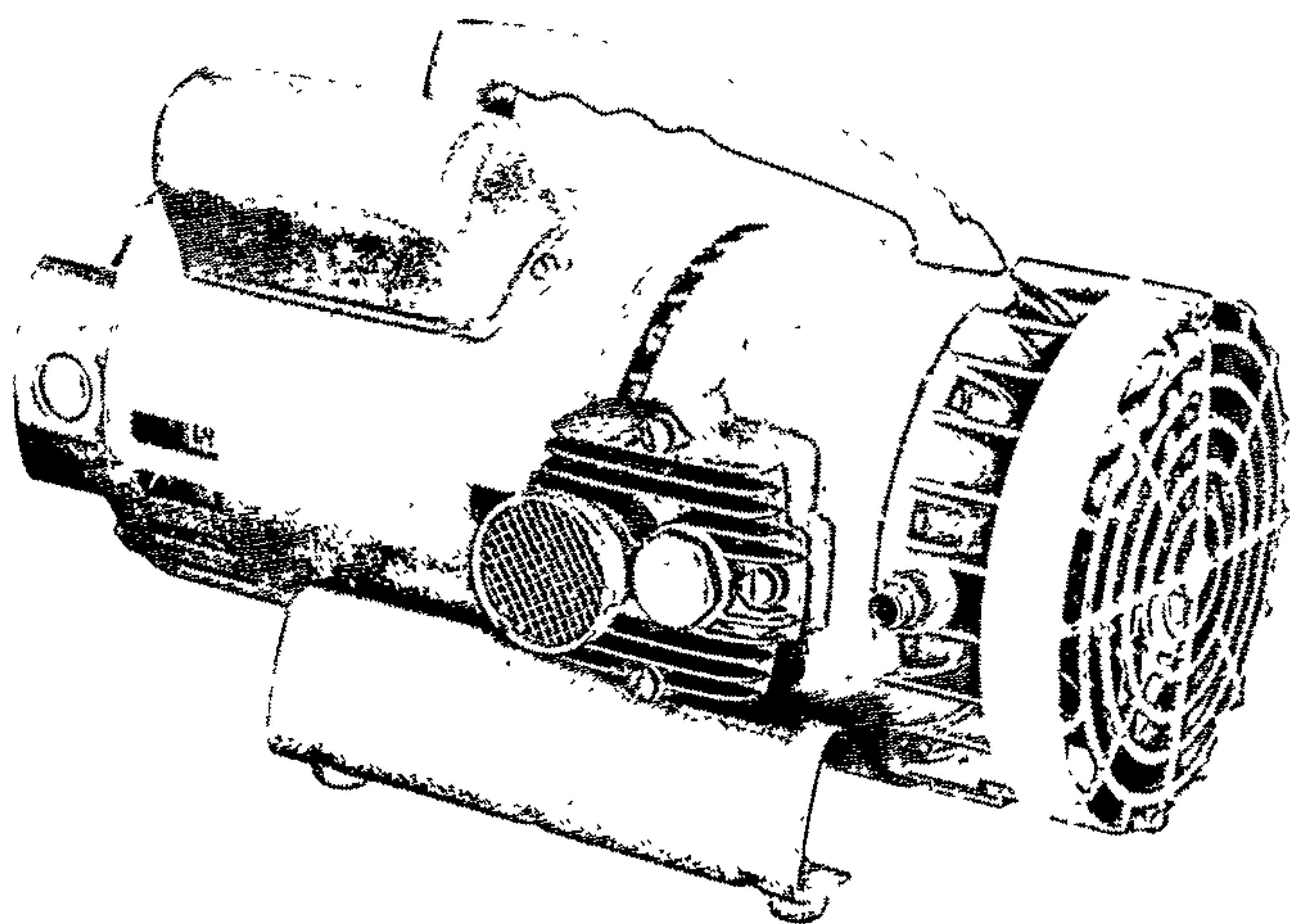
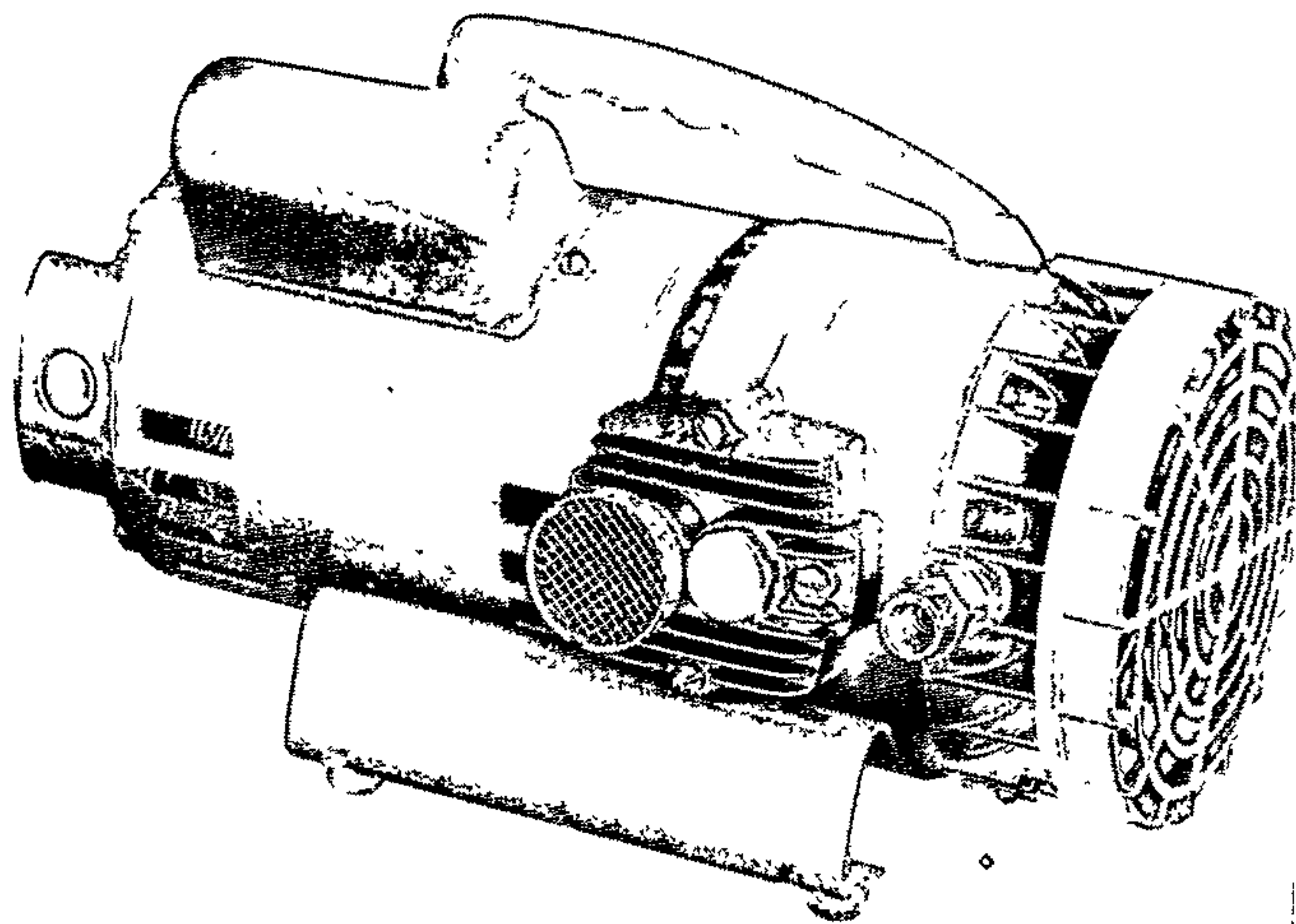
35 LBS. Single Stage Tankless Outfits						
Pressure switch set to cut in at 35 PSIG and out at 50 PSIG						
Model No.	Motor H.P.	Basic Motor Compressor See pgs. 4 & 5	Displacement CFM @ 1725 RPM	Dimensions (in Inches)		
				A	B	
SYCO-1	1/4	SYC5-1	2.7	14 3/8	10 1/2	
SYCO1-1*	1/4	SYC6-1	3.8	14 3/8	11 1/2	
SYCO2-1	1/3	SYC7-1	4.57	15 3/8	11 1/2	
SYCO3-1	1/2	SYC8-1	5.4	15 7/8	11 1/2	
SYCO4-1	3/4	SYC9-1	6.57	16 3/8	11 15/16	
75 LBS. Single Stage Tankless Outfits						
Pressure switch set to cut in at 60 PSIG and out at 75 PSIG						
Model No.	Motor H.P.	Basic Motor Compressor See pgs. 4 & 5	Displacement CFM @ 1725 RPM	Dimensions (in Inches)		
				A	B	
SYCO5-1	1/4	SYC10-1	1.9	14 3/8	10 1/2	
SYCO6-1	1/3	SYC11-1	2.86	15 3/8	11 1/2	
SYCO7-1	1/2	SYC12-1	3.8	15 7/8	11 1/2	
SYCO8-1	3/4	SYC13-1	5.4	16 3/8	11 1/2	
175 LBS. Two Stage Tankless Outfits						
Pressure switch set to cut in at 150 PSIG and out at 175 PSIG						
Model No.	Motor H.P.	Basic Motor Compressor See pgs. 4 & 5	Displacement CFM @ 1725 RPM	Dimensions (in Inches)		
				A	B	C
SYCO10-1	1/3	SYC15-1	1.9	15 3/8	12 13/16	12
SYCO11-1	1/2	SYC16-1	2.7	15 7/8	12 13/16	12
SYCO12-1	3/4	SYC17-1	3.29	16 3/8	13 1/4	12 7/8

*PRESSURE SWITCH SET TO CUT IN AT 30 PSIG AND OUT AT 45 PSIG

Figure 39.



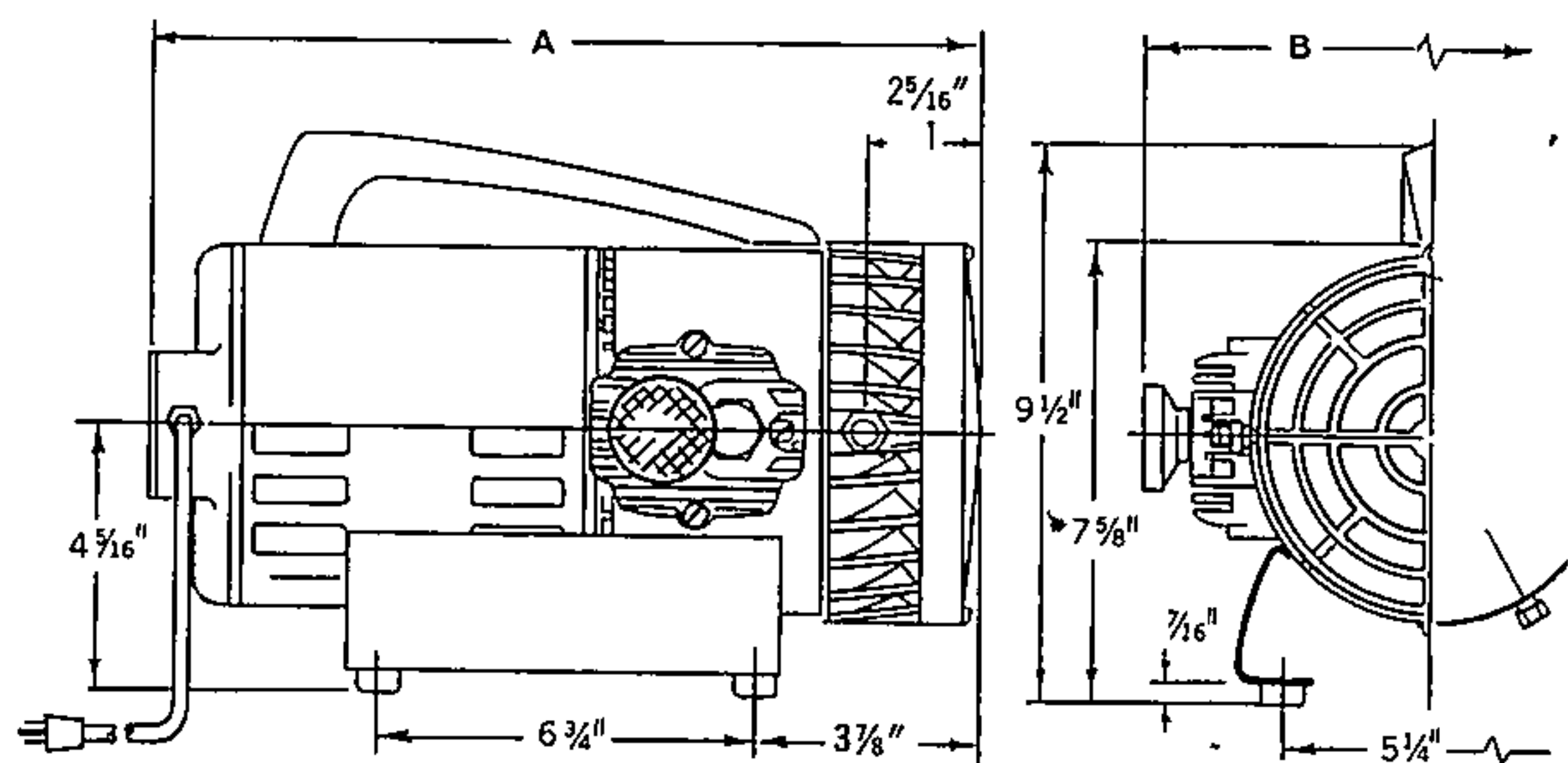
Oil-less MOTOR COMPRESSOR UNITS

**35 LBS. SINGLE STAGE****75 LBS. SINGLE STAGE**

Motor Compressor Units are furnished complete with: Safety Valve—8' of 3 wire cord and plug (115 V. only)—Conduit Connection—Intake Filter (Cylinder Head Port is $\frac{1}{2}$ " NPS)— $\frac{1}{4}$ " NPS Discharge Connection—Carrying Handle—Inter-

gral Pulsation Chamber—Aftercooler—Inter Cooler on Two Stage Units—Automatic Centrifugal Pressure and Moisture Unloader and Check Valves are standard on 75 lb. and 175 lb. units.

35 LBS. SINGLE STAGE



Up to 35 PSIG continuous operating pressure—50 PSIG intermittent

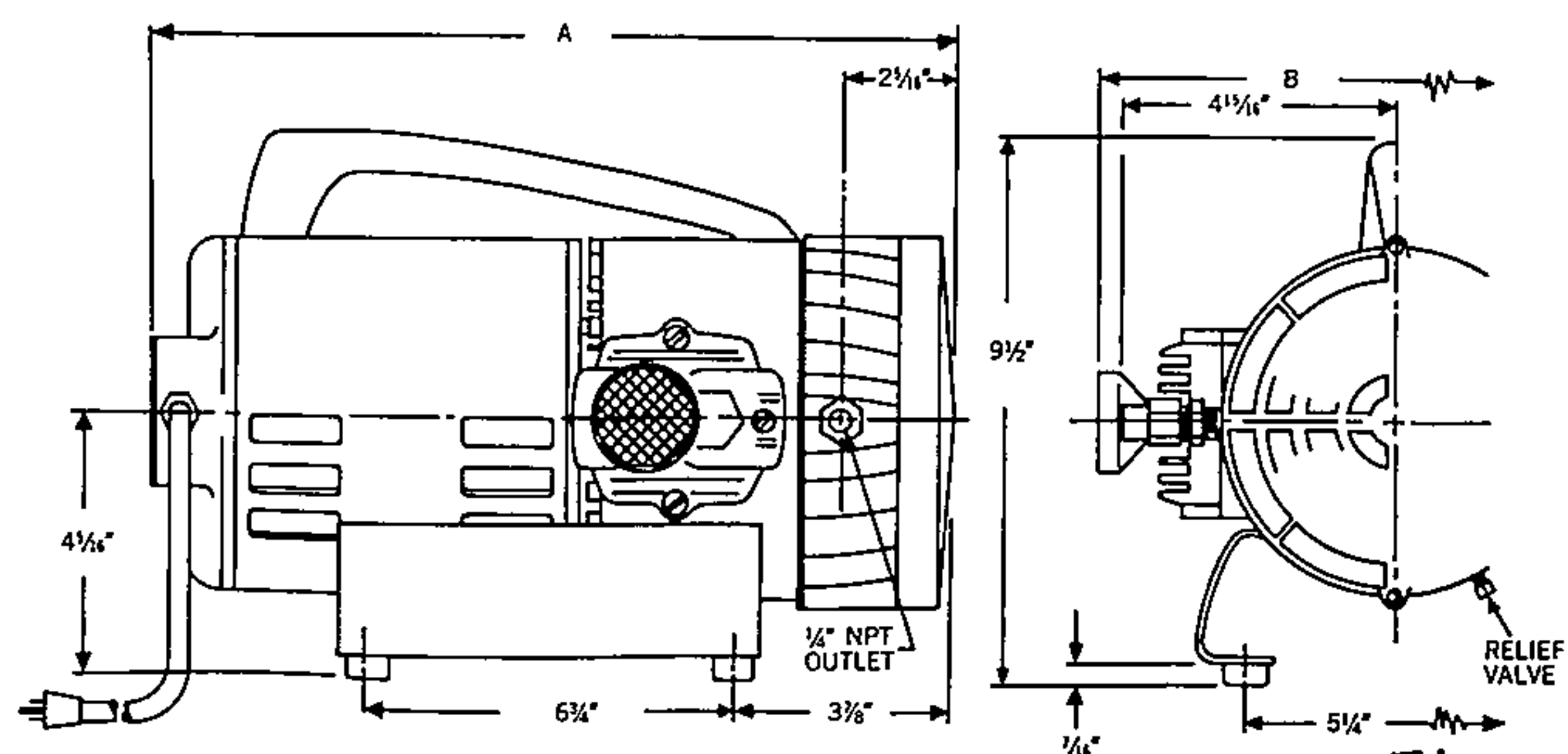
Model No.	Motor H.P.	Number of Cylinders	Displacement CFM @ 1725 RPM	Dimensions (in Inches)	
				A	B
SYC5-1	$\frac{1}{4}$	1	2.7	$14\frac{3}{8}$	$9\frac{7}{8}$
SYC6-1*	$\frac{1}{4}$	2	3.8	$14\frac{3}{8}$	$10\frac{7}{8}$
SYC7-1	$\frac{1}{3}$	2	4.57	$15\frac{3}{8}$	$10\frac{7}{8}$
SYC8-1	$\frac{1}{2}$	2	5.4	$15\frac{7}{8}$	$10\frac{7}{8}$
SYC9-1	$\frac{3}{4}$	2	6.57	$16\frac{3}{8}$	$11\frac{3}{4}$

IMPORTANT: When starting against pressure is required, factory installed Centrifugal Unloader and Check Valve No. SYCZ-1269 (60 cy.)—SYC1Z-1269 (50 cy.) must be specified.

*MAXIMUM INTERMITTENT PRESSURE 45 PSIG.

Refer to page 23 for Free Air Delivery Performance

75 LBS. SINGLE STAGE



Up to 75 PSIG continuous operating pressure—90 PSIG intermittent

Model No.	Motor H.P.	Number of Cylinders	Displacement CFM @ 1725 RPM	Dimensions (in Inches)	
				A	B
SYC10-1	$\frac{1}{4}$	1	1.9	$14\frac{3}{8}$	$9\frac{7}{8}$
SYC11-1	$\frac{1}{3}$	2	2.86	$15\frac{3}{8}$	$10\frac{7}{8}$
SYC12-1	$\frac{1}{2}$	2	3.8	$15\frac{7}{8}$	$10\frac{7}{8}$
SYC13-1	$\frac{3}{4}$	2	5.4	$16\frac{3}{8}$	$10\frac{7}{8}$

Standard equipment includes No. SYCZ-1269 Centrifugal Unloader and Check Valve for full pressure starting.

Figure 40.

<u>Type of Gas</u>	<u>Cylinder Sizes</u>	<u>Average Dimensions</u>	<u>Average Weight Full</u>	<u>Cost of Gas</u>
Medical Oxygen	240 Cu.Ft.	5' Long x 9" Diameter	127 lb.	\$7.00
	120 " "	3'6" " x 8" "	70 " "	3.50
	48 " "	3' " x 5" "	28 " "	1.90
	14.4 " "	1'8" " x 3" "	20 " "	0.65
Compressed Nitrogen	220 Cu.Ft.	5' Long x 9" Diameter	123 lb.	\$6.48
	110 " "	3'6" " x 8" "	68 " "	3.24
	44 " "	3' " x 5" "	28 " "	1.30
Carbon Dioxide	33 Pound	3'6" Long x 8" Diameter	93 lb.	\$3.04
	13½ " "	3' " x 5" "	38 " "	1.50
	4 " "	1'8" " x 3" "	22 " "	1.50
Nitrous Oxide	16,000 Litres	5' Long x 9" Diameter	175 lb.	\$49.60
	8,000 " "	3'6" " x 8" "	94 " "	24.80
	900 " "	1'8" " x 3" "	16 " "	3.20
	450 " "	10" " x 3" "	12 " "	1.75
Cyclopropane	350 Litres	10" Long x 3" Diameter	12 lb.	\$30.50
	150 " "	8" " x 2½" "	6 " "	14.00
Medical Air	240 Cu.Ft.	5' Long x 9" Diameter	127 lb.	\$3.12
	120 " "	3'6" " x 8" "	70 " "	1.56
	44 " "	3' " x 5" "	28 " "	0.58
	14.4 " "	1'8" " x 3" "	20 " "	0.58
Medical Dry Breathing Air	240 Cu.Ft.	5' Long x 9" Diameter	127 lb.	\$3.48
	120 " "	3'6" " x 8" "	70 " "	1.74
	44 " "	3' " x 5" "	28 " "	0.64
	14.4 " "	1'8" " x 3" "	20 " "	0.64

Table 14.

Generators: In many field situations there is a requirement for generated power to operate lights, dental unit, etc.

There are many good petrol driven generators on the market. Typical of these are those manufactured by "Honda". These are shown in Figures 42, 43, 44.

Other types by "Kawasaki", are shown in Figure 45.

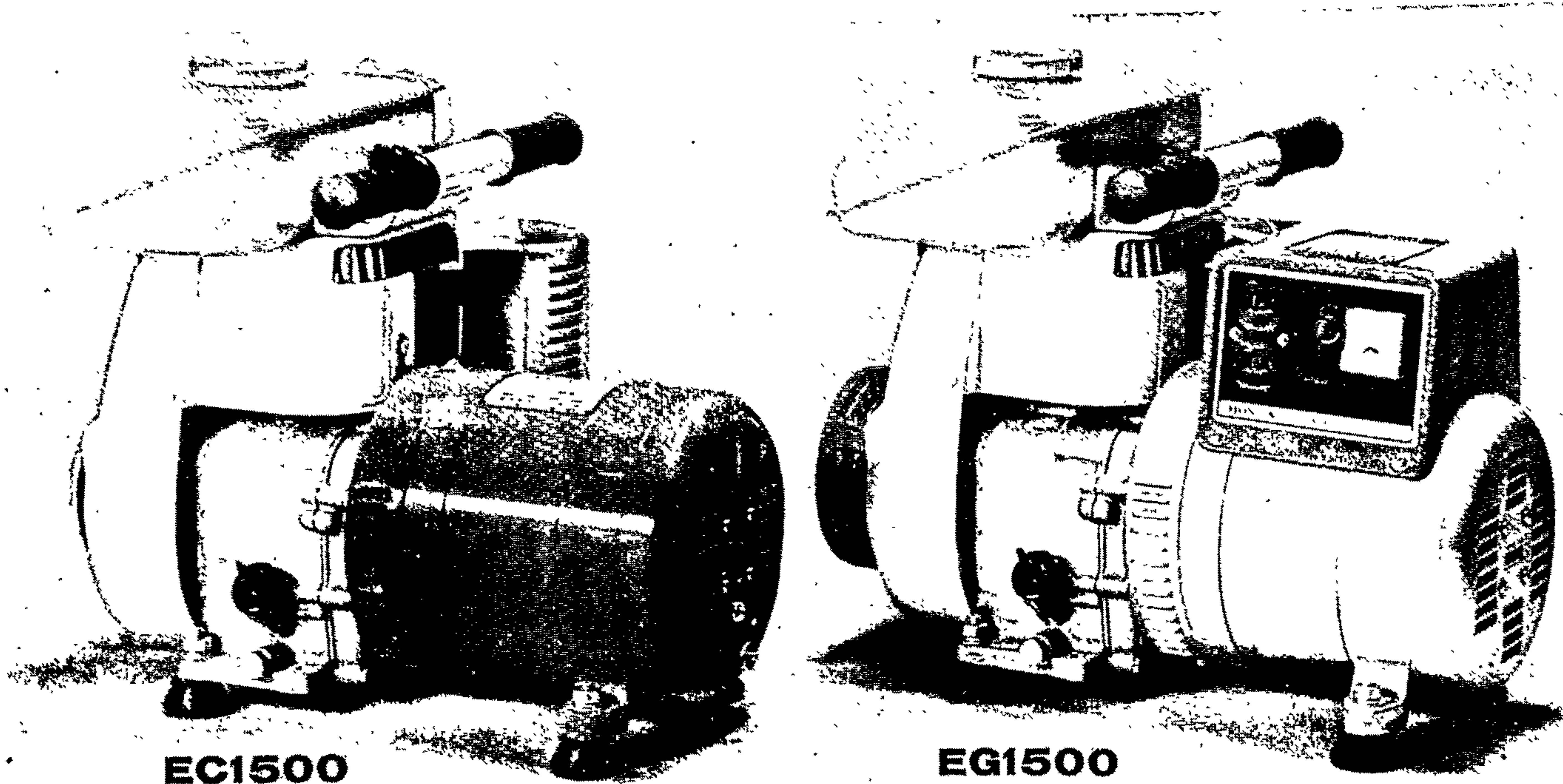


Figure 42.

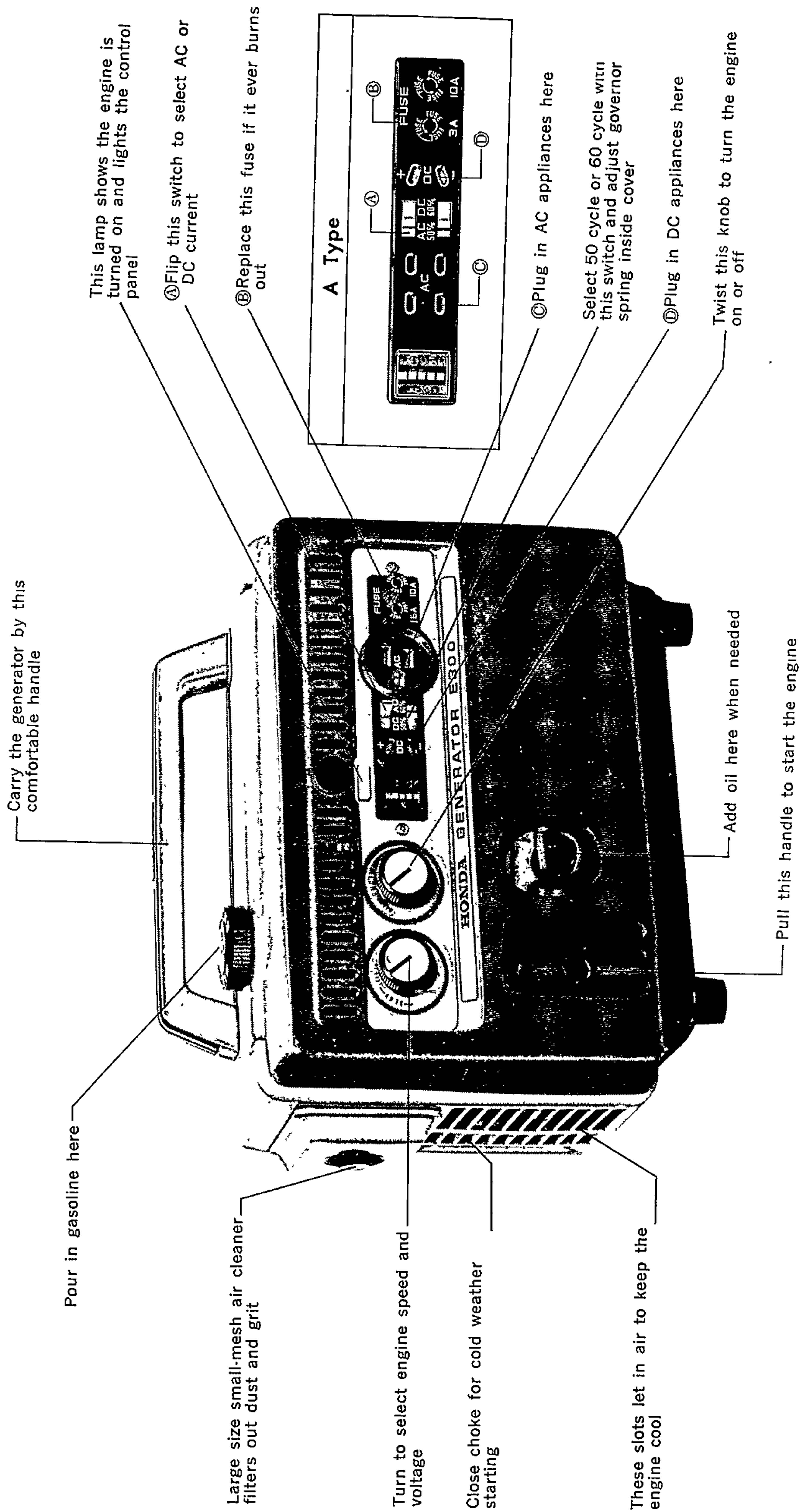


Figure 43.

E300 E or U Type

HONDA PORTABLE GENERATOR SERIES

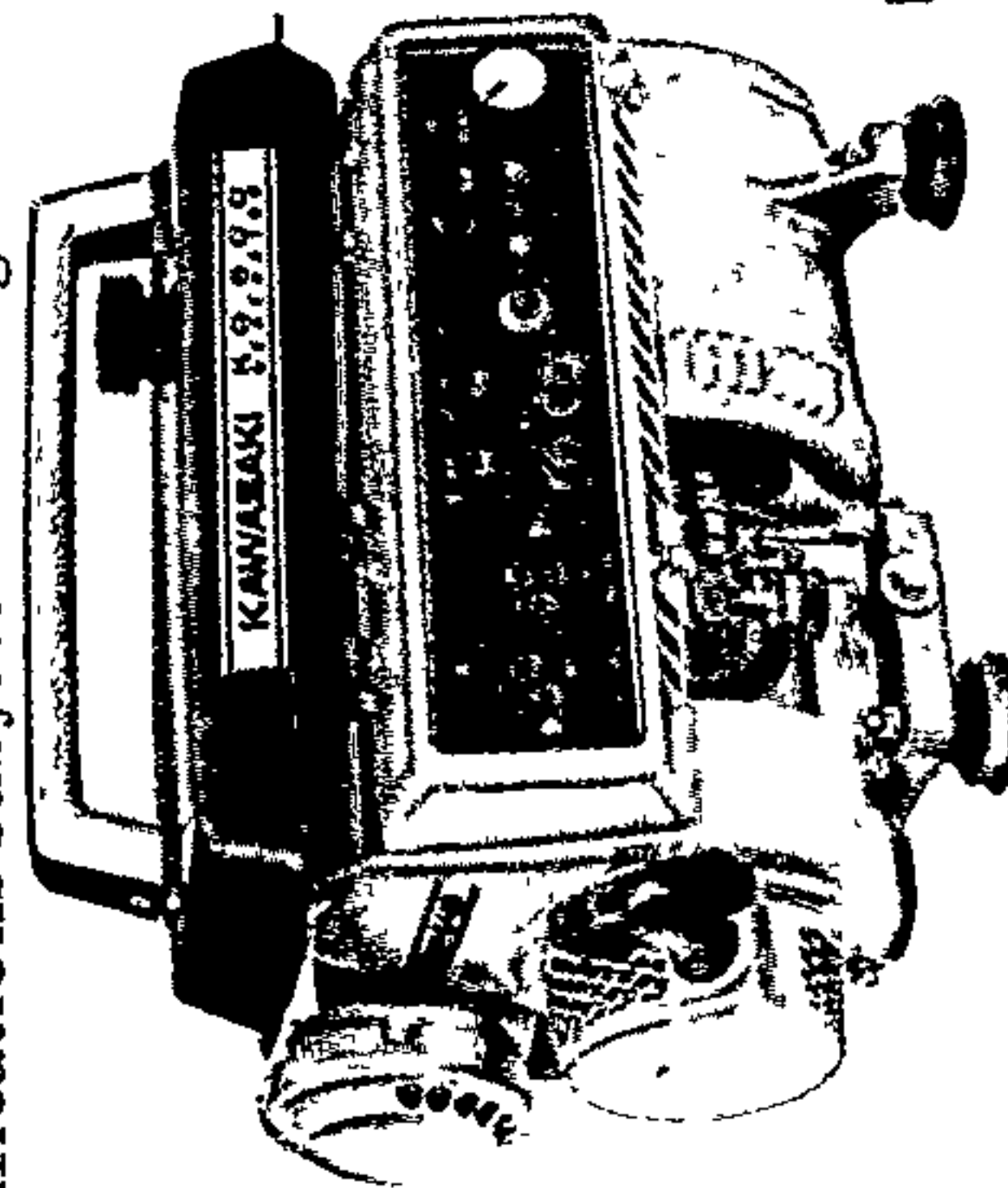
	E80 (80 W) AC		E300 (300 W) AC/DC		E1500 (1500 W) AC/DC		E2500 (2500 W) AC/DC		E4000 (4000 W) AC/DC		EC1500 (1500 W) AC		EG1500 (1500 W) AC		ED250 (250 W) DC		ED1000 (1000 W) DC
--	------------------	--	-----------------------	--	-------------------------	--	-------------------------	--	-------------------------	--	-----------------------	--	-----------------------	--	---------------------	--	-----------------------

Figure 44.

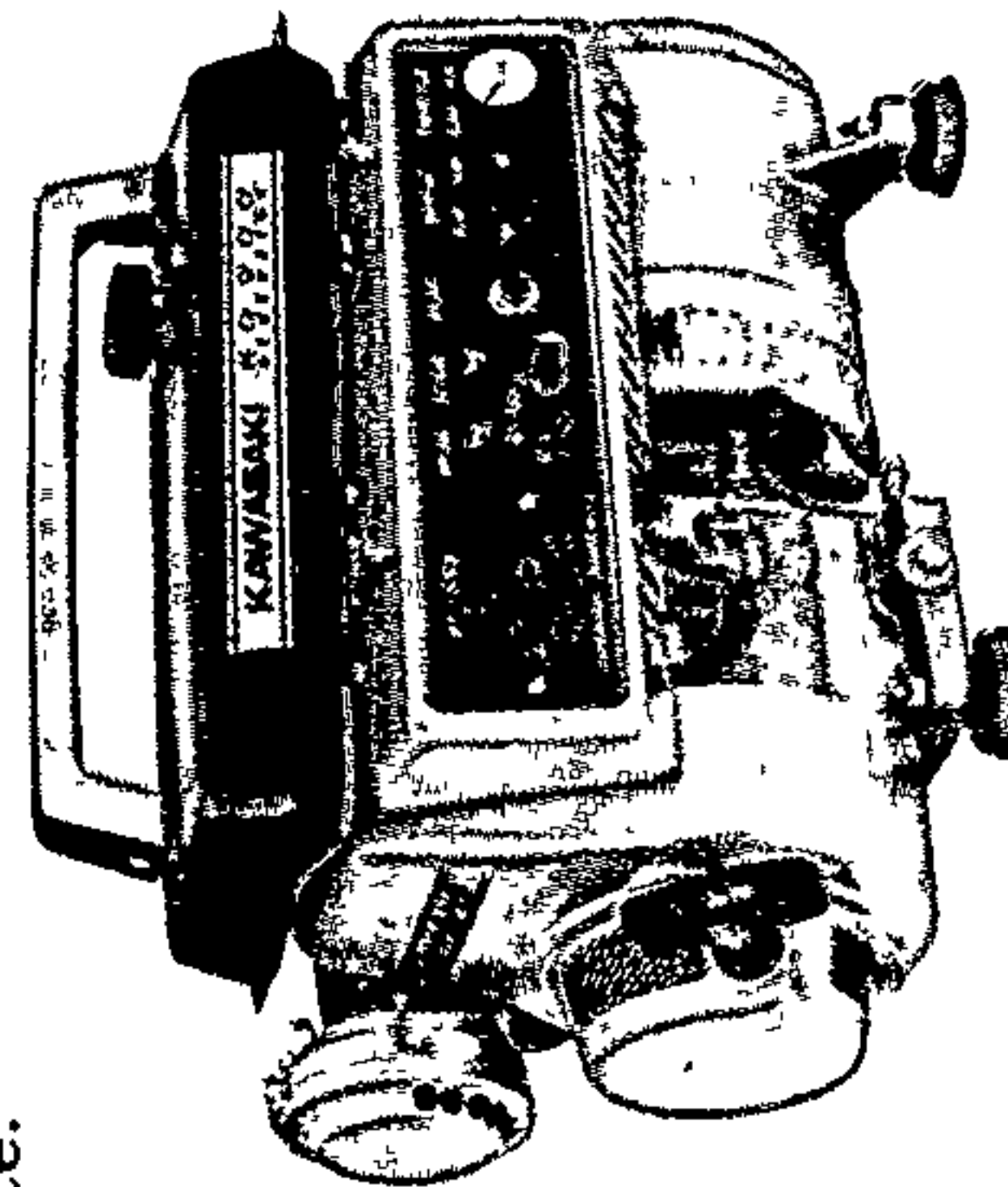
Specifications		KG 600	KG 900	KG 1300
A C	Cycles (C/S)	60		
	Max. output (W)	750	1100	1600
	Output (W)	600	900	1300
	Volts (V)	100		
	Ampere (A)	6.0	9.0	13.0
D C	Volts. Watts	12V. 100W		
	Engine	4-cycle, air cooled, gasoline engine		
Fuel tank capacity		3.0 lit. (0.8 US gal) for 4.5 h.	3.0 lit. (0.8 US gal) for 4 h.	5.0 lit. (1.3 US gal) for 4.5 h.
Dry weight		25.5 kg (56.1 lbs)	30.5 kg (67.1 lbs)	42.5 kg (93.5 lbs)
Dimensions		454×255×376mm (17.9×10.0×14.8 in)	503×268×399mm (19.8×10.6×15.7 in)	580×315×420mm (22.8×12.4×16.5 in)

* There are also 50 %, 220 V, and 50 %, 100 V types for each model. They have 20% less output.

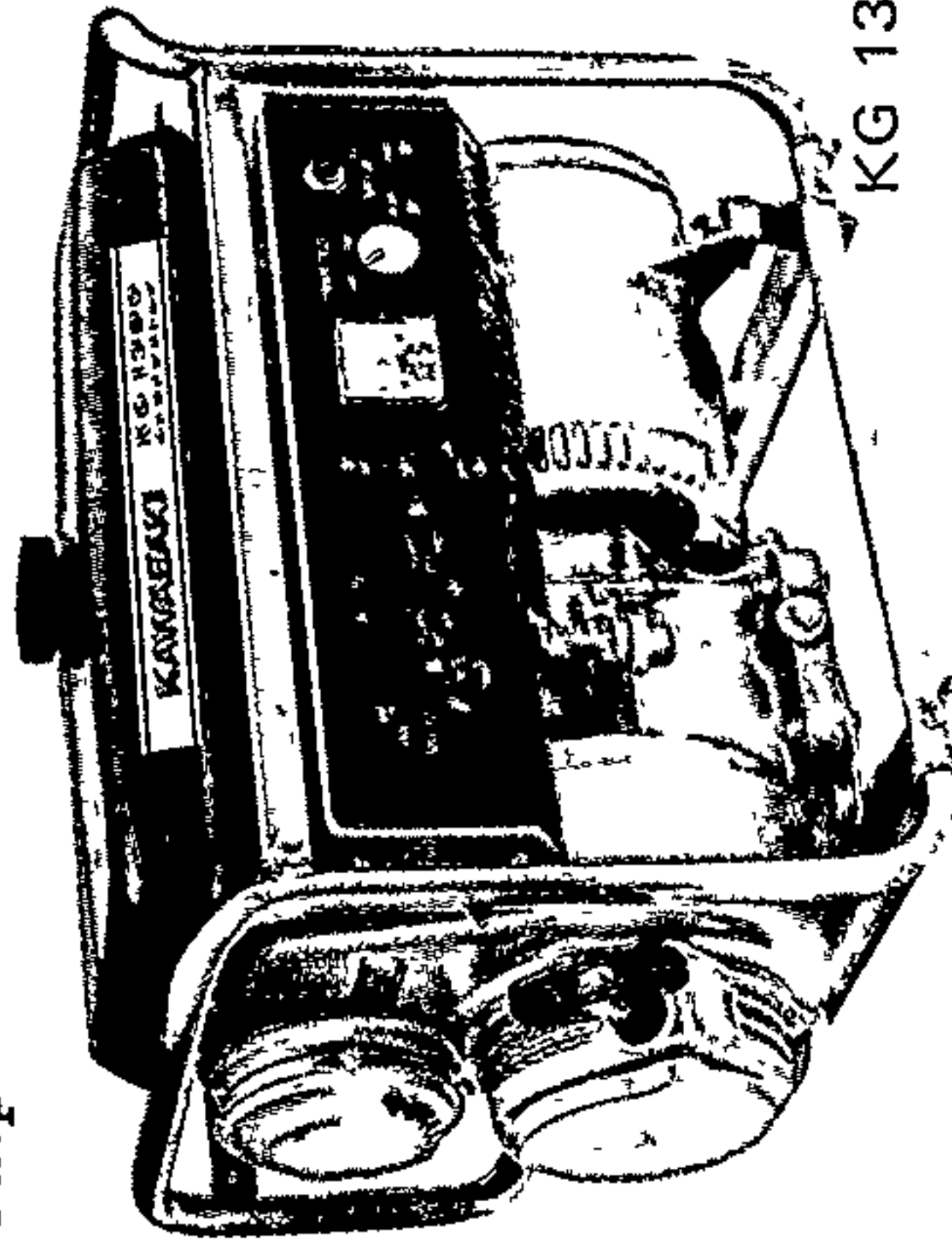
* Specifications subject to change without notice.



KG 600



KG 900



KG 1300

Figure 45.

Lights: a) Conventional - these are of two types.

i) Mains-power operated. These are standard dental quartz iodide - tungsten halogen lights, as shown in Figure 46, and are mounted on a portable stand or bracket. Vol.2, Plate 76 shows a light set up in this manner. Table 15 gives the specifications of a typical light of this type.

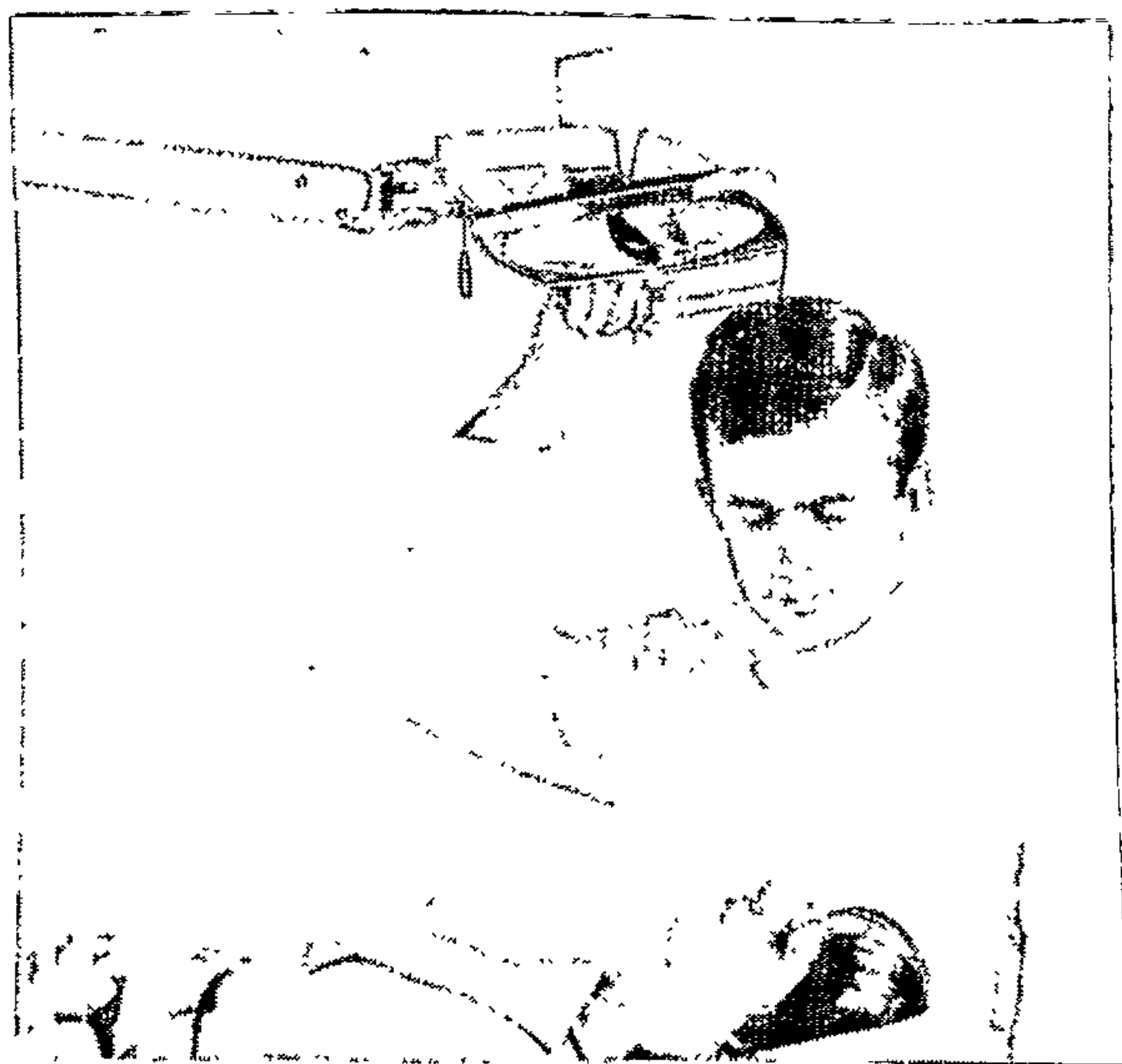


Figure 46.

Specification

Light Intensity at focal distance of 91 cm (36 in.).	Low High	10,500 lux 14,000 lux	1,000 lumens 1,300 lumens
Colour Value (<i>approx.</i>)		3,300 °K	
Lamp Life (<i>Estimated</i>)		15,000 hr	at 10,500 lux
Focal Distance	Between	76–106 cm	30–42 in.
Beam Pattern (<i>approx.</i>) at focal distance of 91 cm (36 in.)		30×9.5 cm	12×3 $\frac{3}{4}$ in.
Finish	Standard Colour Optional Colours Plated Parts	FIDE Grey 103 FIDE range and Ivory Tan Satin and bright chrome	
Electrical Rating <i>Please state Mains voltage when ordering</i>	Mains Lamp Voltage	200–250V A.C. or 110V A.C. 12.8–14.1 volts	0.5 amp 1.0 amp
UNIT MODELS	Maximum extension of arms Net weight (<i>approx.</i>) Fittings for most contemporary units are available.	141 cm 16.3 kg	55 $\frac{1}{2}$ in. 36 lb
WALL MODEL	Maximum extension of arms Net weight	184 cm 14.0 kg	72 $\frac{1}{2}$ in. 31 lb
FLOOR MODEL (Fixed)	Maximum extension of arms Net weight (<i>approx.</i>) Clearance to underside of primary arm normally 150 cm (59 in.).	175 cm 29.0 kg	69 in. 64 lb
CEILING MODEL <i>Please state ceiling height when ordering</i>	Maximum extension of arms Net weight (<i>approx.</i>) Clearance to underside of primary arm approximately 150 cm (59 in.).	175 cm 27.2 kg	69 in. 60 lb

Table 15.

to faultless efficiency.

[illegible][illegible]

ii) Battery and/or power operated. The most popular of this type, in use by the Australian Armed Services and State Public Health Departments is the "Planet" light. These can run off a 12V battery, or off mains power, through a transformer. They can be mounted on a trolley base, bracket, clamp etc., as shown in Figure 47. Also Vol.2, Plate 34.

b) Fibre Optic: These cold intense lights are being increasingly used in dentistry and the fibre bundles are shown in Vol.2, Plate 54 in the Midwest "Oraluminator". Attachments can be made to various instruments, Plate 55, showing the Dentsply "Biolite".

Portable fibre optic systems are now available, the "Roland IDS" as shown in Figure 48.

Vol.2, Plate 56 shows two new fibre optic portable lights. The one on the right has a magnetic base and can attach itself to any metal surface - the Litema Puraflex Mini. The one on the left is self contained with handpiece, mirror, and fibre light, all in a small box - the Dentaureum Flexi Starlight.

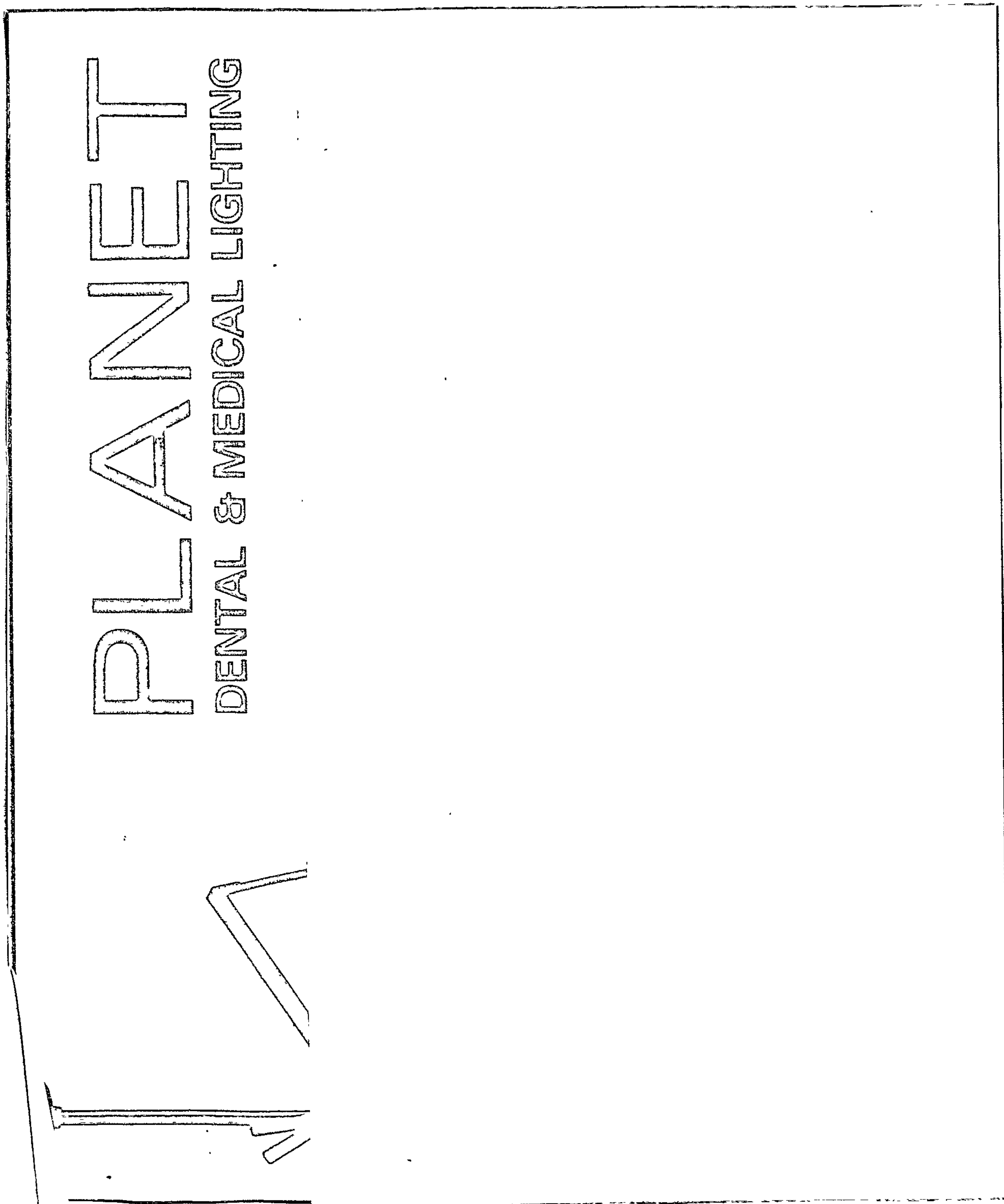
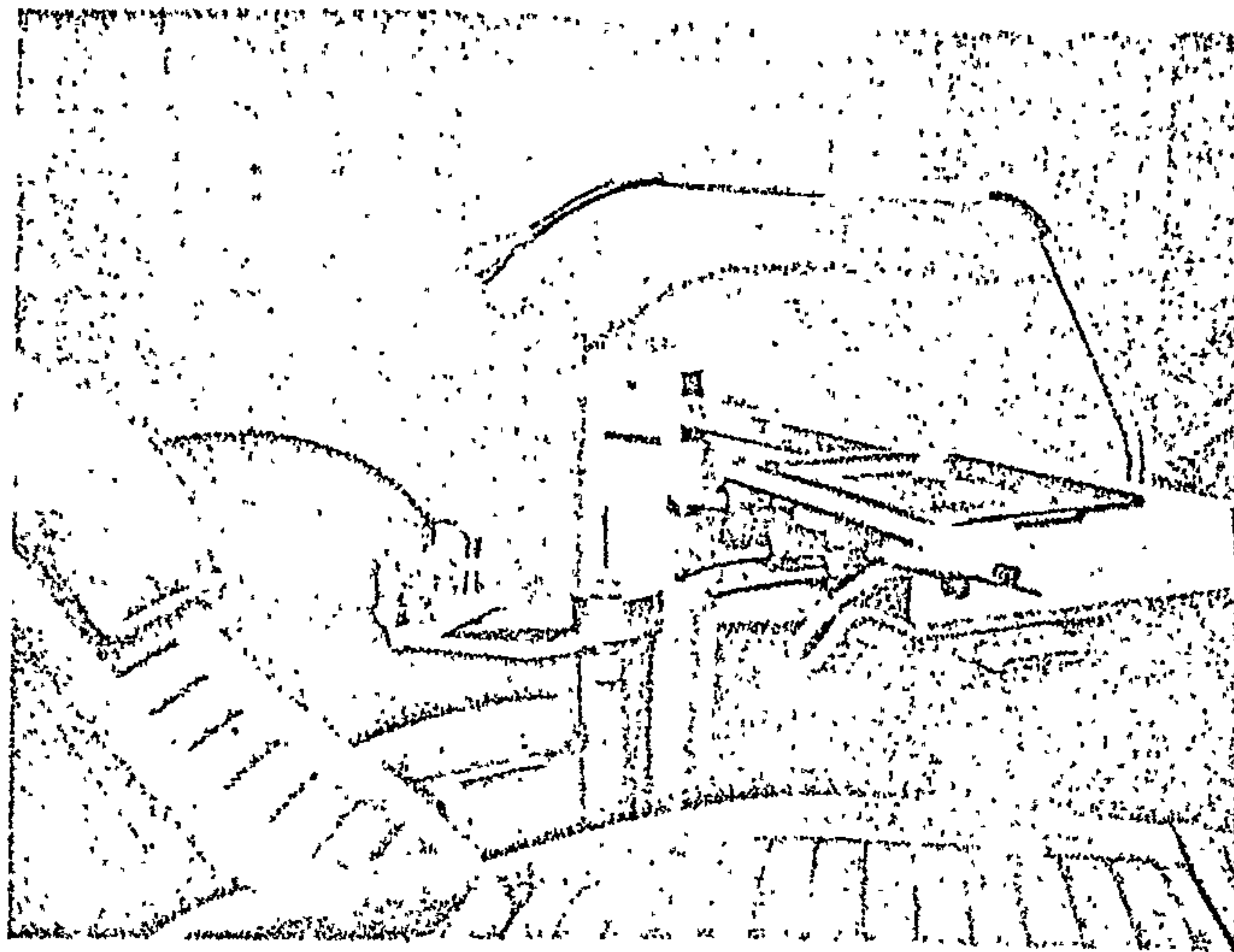
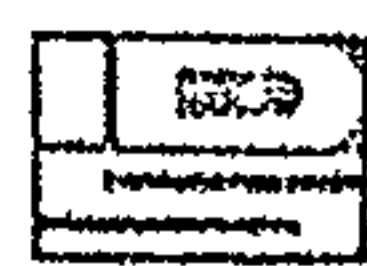


Figure 47.



COMPACT • FLEXIBLE • CONVENIENT



ROLAND

**INSTRUMENT DELIVERY
SYSTEMS**

A completely air operated system that is easy to install, has earned a reputation for reliability and performs efficiently for dentists who work seated or standing—or both. All this and moderately priced!

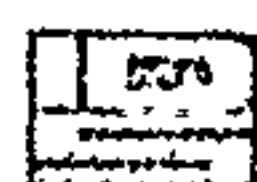
...and NOW a major breakthrough in operating lighting... NEW Fiber Optics (cold) operating light... See as you've never seen before!



New
Fiber
Optics
Operating
Light

You must see and try the ROLAND IDS to appreciate the concept. Send for descriptive brochures.

Engineering with Imagination.



ROLAND

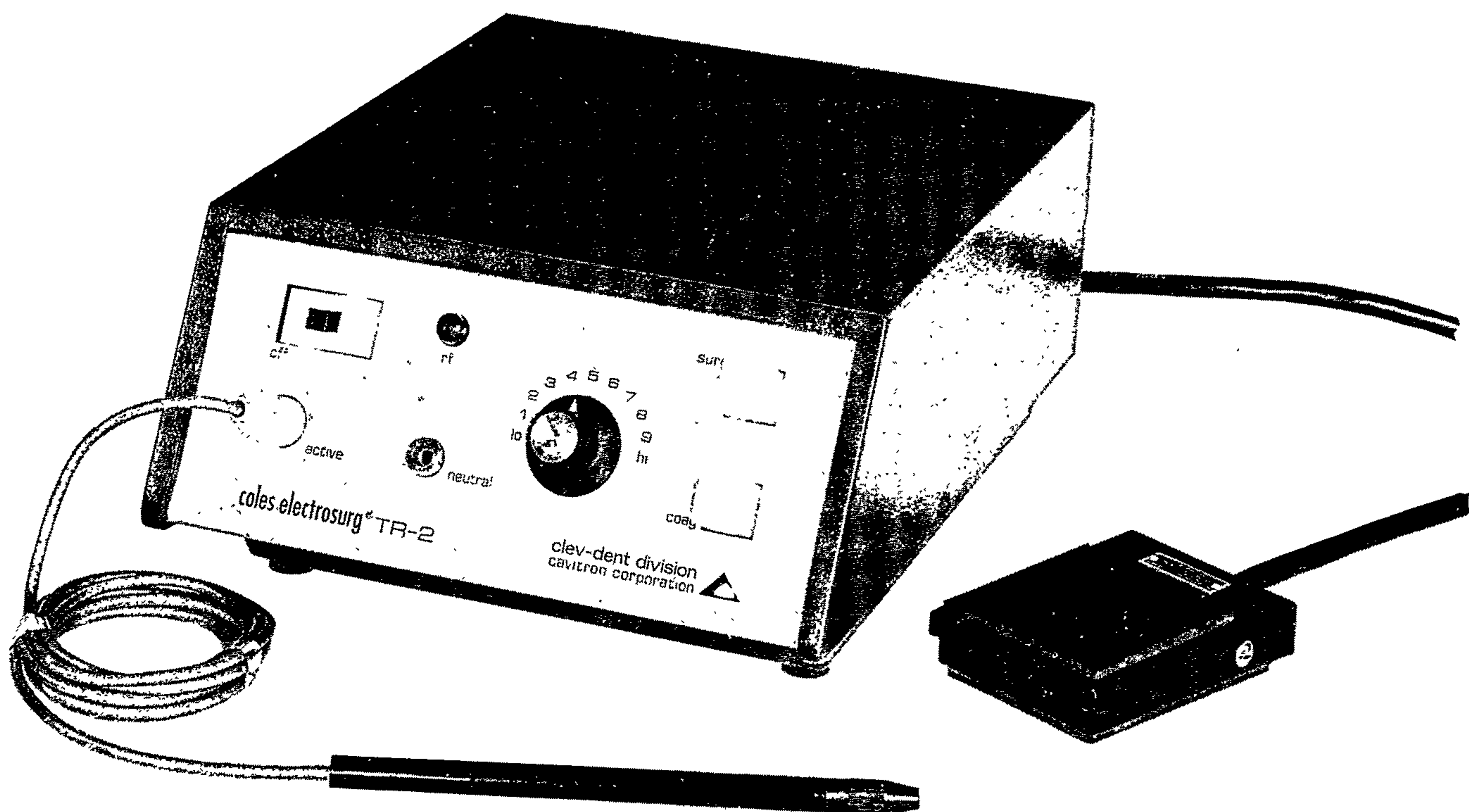
Manufacturing Company, Inc.

4000 Campbell Avenue, Menlo Park, Calif. 94025

Figure 48.

Electrosurgery: With the advent of small transistorized circuits, new developments have taken place in electro-surgery. One example of this type of equipment is the "Coles Electrosurg TR-2" by Cavitron shown in Figure 49.

coles electrosurg TR-2



Another great advance in electrosurgery units from Clev-Dent! Now, it's the new economical Coles Electrosurg TR-2. It's solid state and fully transistorized which means there are no tubes to burn out. Like the new TR-1, it has fully rectified and filtered cutting current, a single handpiece on coaxial cable and power enough for all dental procedures. The TR-2 also features push button controls and fully rectified coagulating current. In addition to its extreme light weight — only 12 lbs, it has an automatic voltage regulator. In event of a drop-off in power, the unit will keep output at a constant level.

The TR-2 combines three great names in the dental trade:

COLES, CAVITRON AND CLEV-DENT

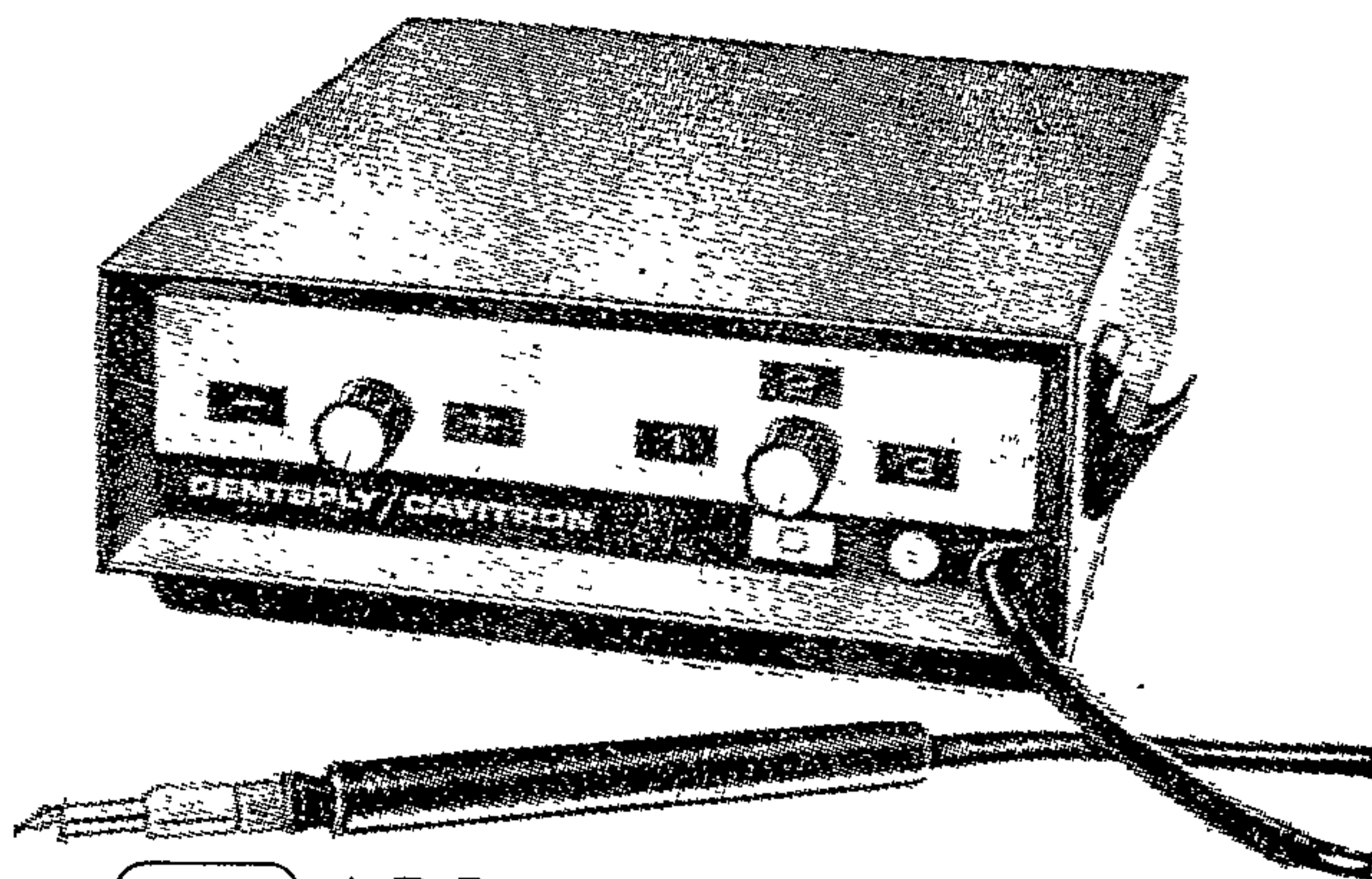
It reflects the most advanced technology available in electrosurgery units today.

Figure 49.

Ultrasonics: This new development in oral prophylaxis has resulted in the manufacture of machines to produce ultrasonic vibrations. Typical of this equipment is the "Cavitron" by Dentsply, shown in Figure 47. The specifications of this machine are given in Table 16. Also shown mounted on a trolley, Vol.2, Plate 50.

*there's so much
more to the*

**CAVITRON
700**



A D INTERNATIONAL (AUST.) PTY. LTD.
116 QUEENSBERRY ST. CARLTON. VIC. 3053

Figure 50.

CAVITRON 700

SPECIFICATION

Standard accessories supplied with each Cavitron 700 model

- Handpiece, designed to accept various inserts suited to the operation in hand.
- Three popular scaling inserts
P.1, P.3, P.10.
- Foot control which activates the insert tip with light toe pressure.

Dimensions

Cabinet size: Height 8.5 cm (3.25")
Length 27 cm (10.5")
Width 21 cm (8.25")

Weight

6 kg (13 lb) net

Electrical

220–240 volts
50/60 cycles
0.6 amps. Fuse rating 1 amp

Water

Normal mains supply 0.7 kg/cm²–4.2 kg/cm²
(10 lb/in²–60 lb/in²)
If required, a portable water tank, fitted with a pump and gauge is available.

Finish

Standard: Dark grey cover with satin chrome facia.

Table 16.

Stools: Should be adjustable, have a good posture and comfortable seat, with backrest. A good example of this is the Bendix "Powerlift 5", as shown in Figure 51.

In Vol.2, Plate 70 examples are shown of operating stool in place.

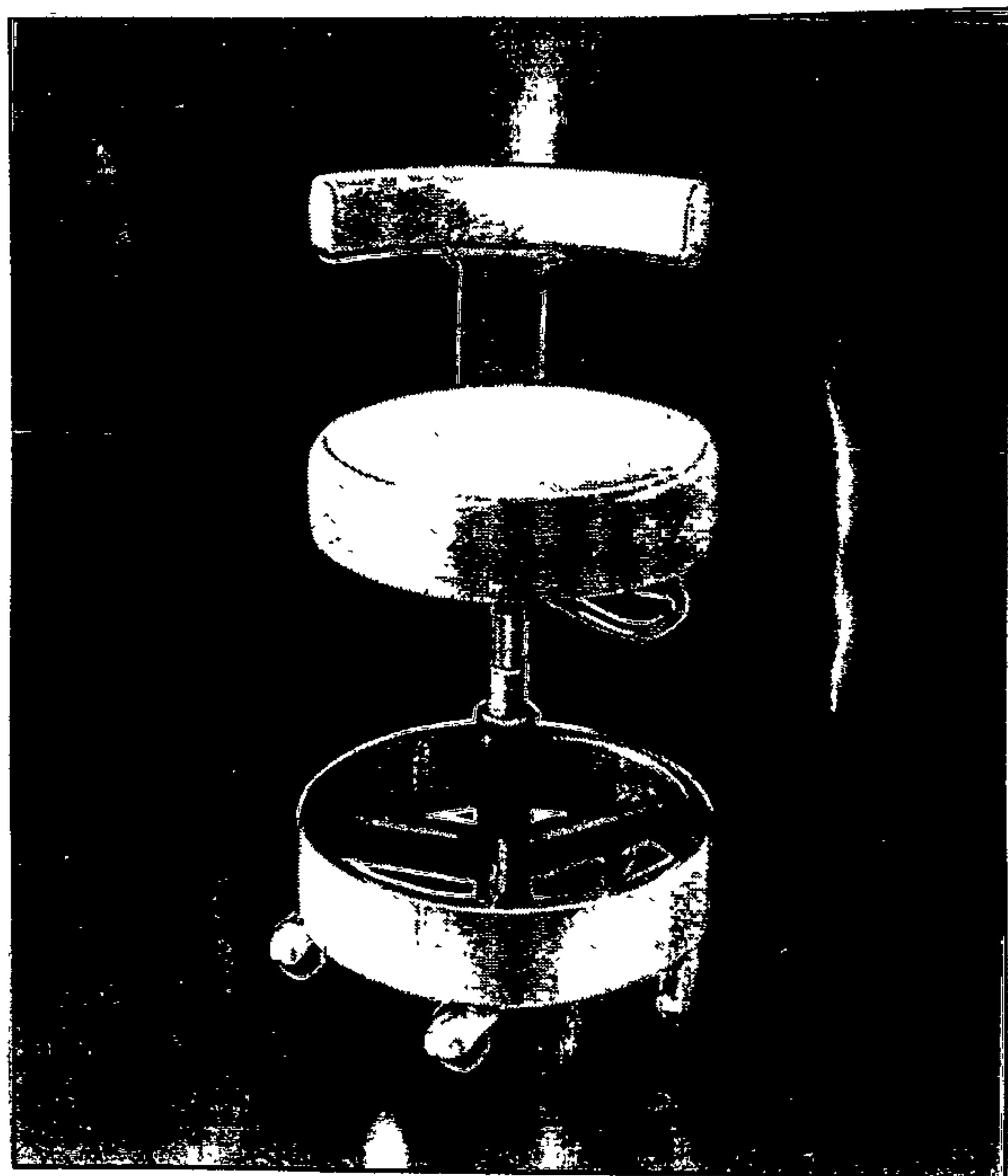


Figure 51.

Handpieces: These are precision instruments and should be cared for and maintained according to the manufacturers instructions.

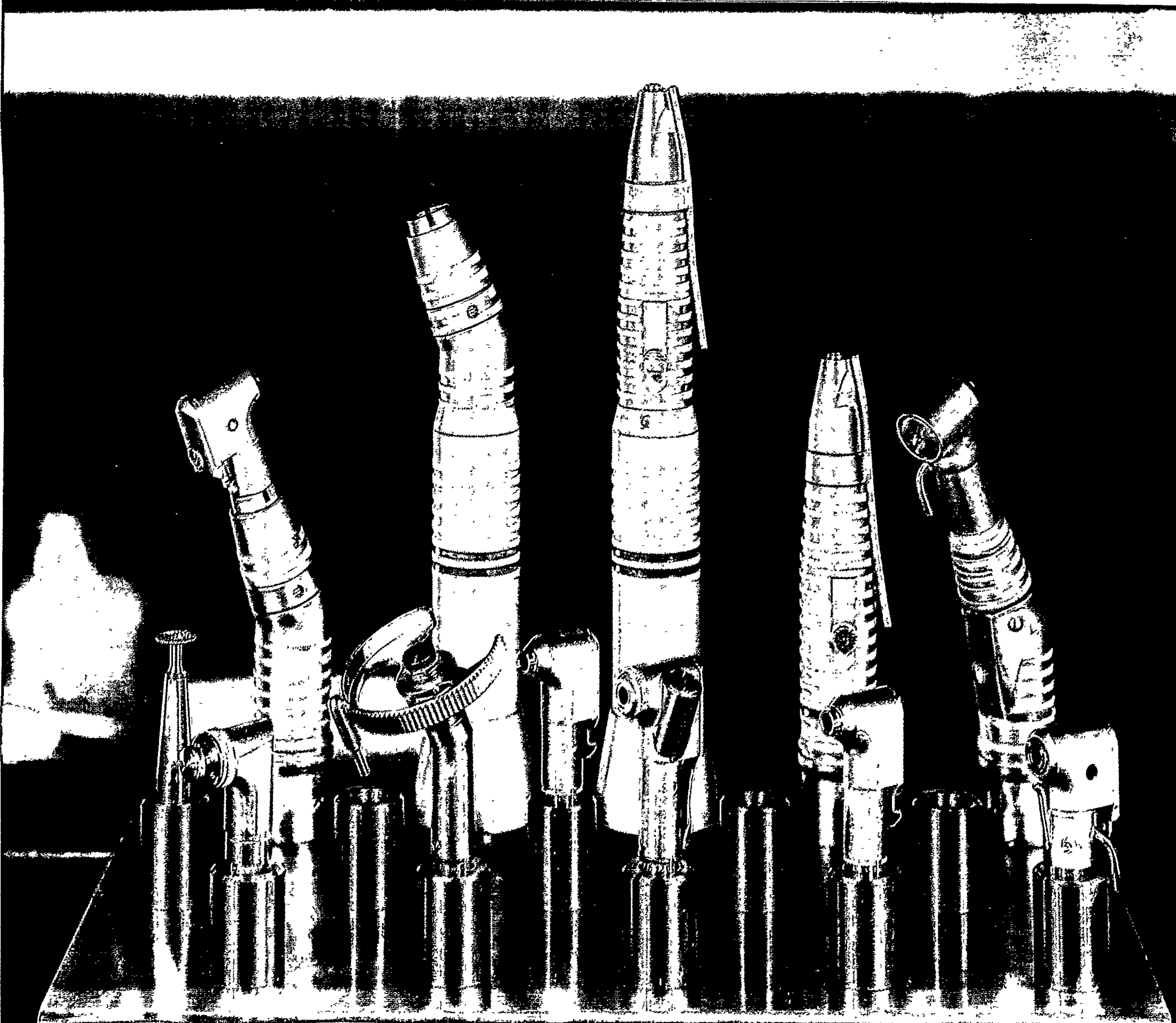
There are a large number of different types of handpieces available. Figure 52 shows the range of KAVO conventional electric handpieces available.

Figure 52.



INTRA-Quick System

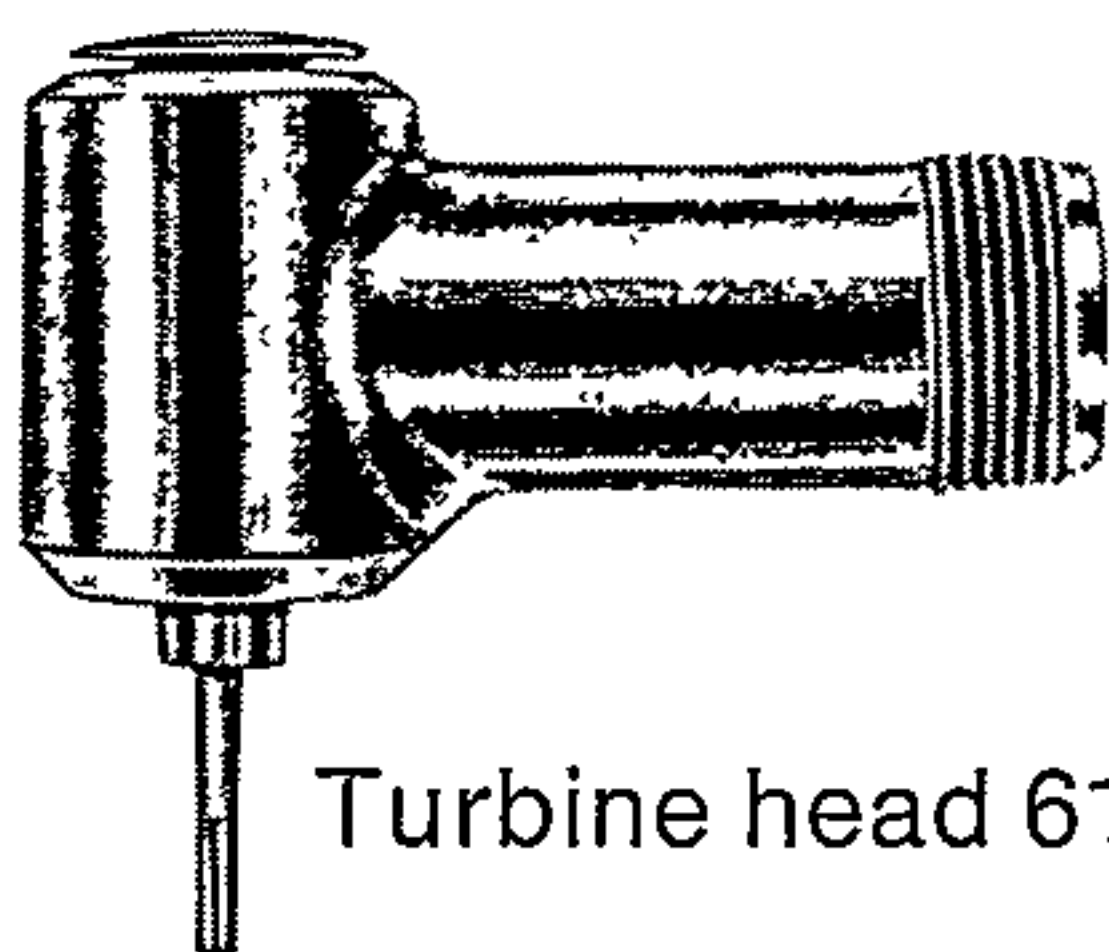
for micro-motors - airmotors - electric engines



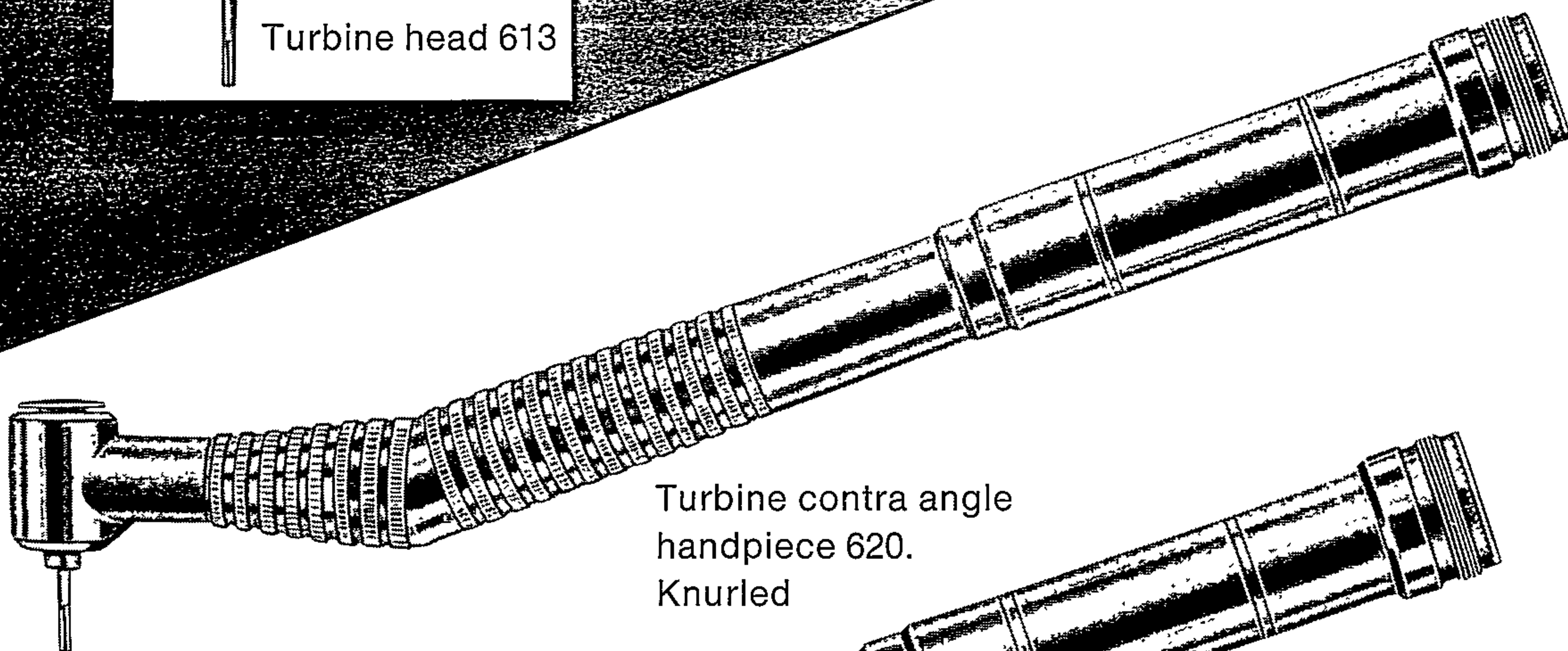
In respect of air-rotors, the "Borden Airotor" (R) was the first successful commercial airotor handpiece developed. Figure 53 shows the two basic types of airotors.



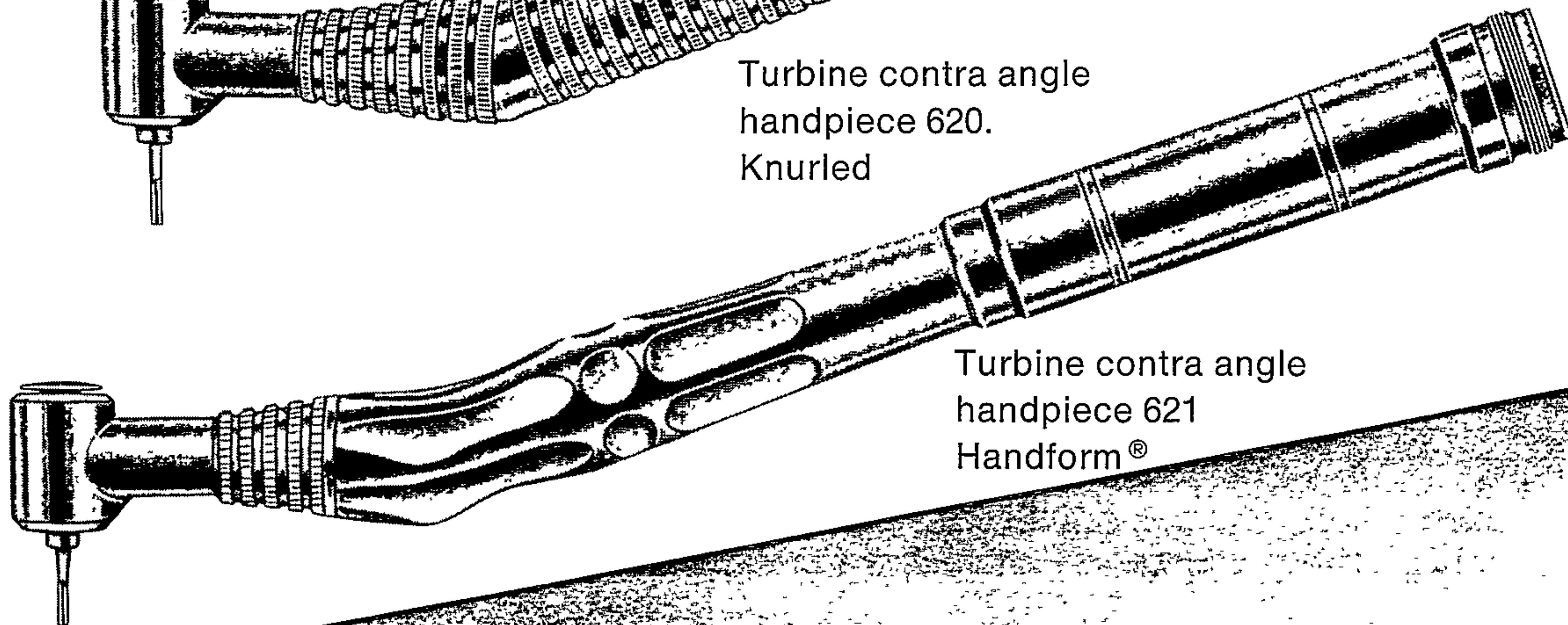
Borden-Airotor[®] „68”



Turbine head 613



Turbine contra angle
handpiece 620.
Knurled



Turbine contra angle
handpiece 621
Handform[®]

Figure 53.

There has been a change from the use of precision ball bearings to an all-air handpiece, that is quieter, frictionless and faster. Compare Figure 54 with Figure 55.

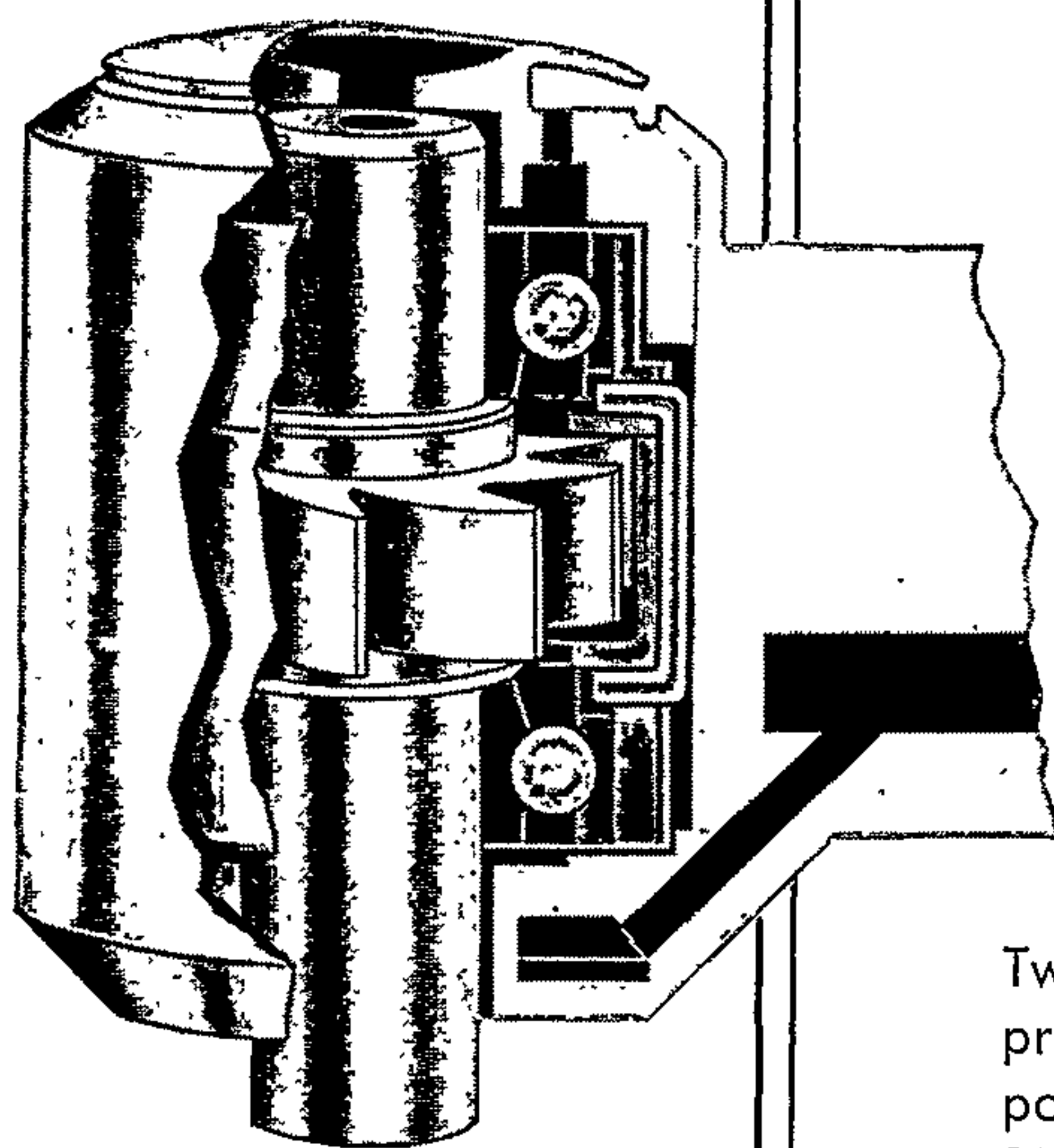


Figure 54.

The Turbine the Heart of the KaVo Borden Airotor

Two stainless steel miniature precision ball bearings produce almost frictionless running and thus make it possible to achieve high turbine speeds of from 300,000 to 320 000 r. p. m. The design of the turbine wheel and the regulation of the air flow in accordance with the latest technical advances ensure high torque.

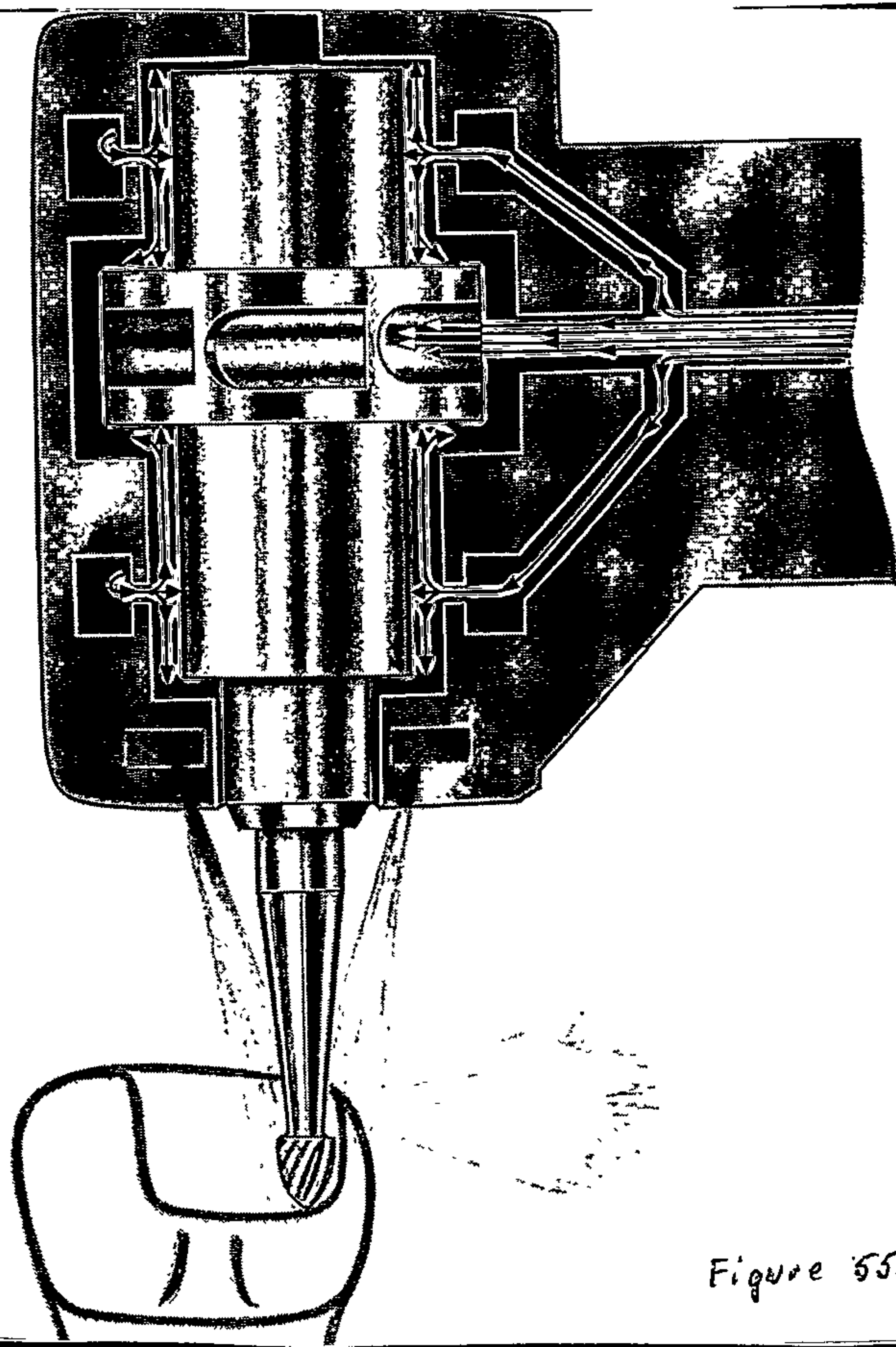


Figure 55.



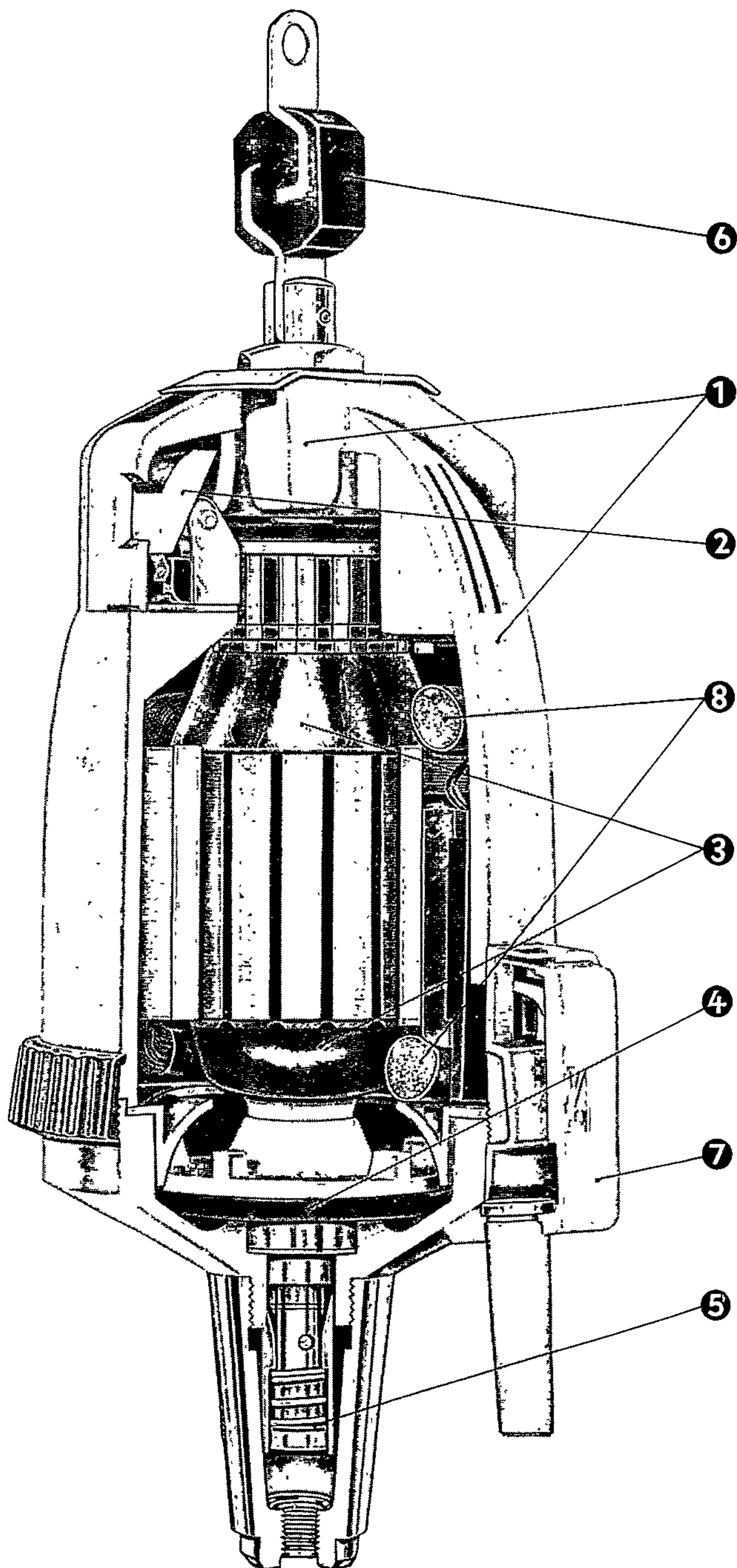
All-air®

KaVo All-air offers:

- Quiet running without vibration.
- 420 000 – 450 000 r.p.m.
- Very small air-bearing turbine head.
- Weight of complete handpiece: 2½ ozs only.
- Negligible air exhausted into the cavity.
- Twin spray guarantees efficient cooling.
- Concentric running metal chuck.
- Interchangeable turbine head.
- Guarantee per turbine head: 6 months.
- When purchasing with spare head the guarantee for both heads is one year.

Existing Borden equipment can be converted to All-air operation. Air requirements 25–28 ltrs./min. at 51.4/54.4 p.s.i.

Laboratory Motors: A series of portable electric laboratory motors is shown in Vol.2, Plate 10. These can be mounted as shown in Plate 72. Figure 56 shows an "exploded" section of a typical laboratory motor. Figure 57 shows the various arrangements that can be used with these motors.



The KaVo Universal Motor

Protective insulation - stable speeds - ball-bearings throughout

- Type 534 - 6,000 r. p. m. - 150 Watts - Colour ring „black“
- Type 535 - 12,000 r. p. m. - 200 Watts - Colour ring „yellow“
- Type 536 - 18,000 r. p. m. - 300 Watts - Colour ring „blue“
- Type 537 - 24,000 r. p. m. - 350 Watts - Colour ring „red“

The superlative design of the motor is characterised by many advantages. In the sectional view shown alongside, the most important features are highlighted:

- ① Double insulation in accordance with Class II of VDE Standard 0740, achieved through a high-strength, moulded plastic housing made of polyester resin reinforced with glass-fibre.
- ② Carbon-brush indicator visible from outward, making it possible to change the brush in good time.
- ③ Complete protection of the armature winding with special resin.
- ④ Multiple ventilation system cools bearings and electrical parts. (No overloading of motor!)
- ⑤ Instrument cable fitted with rapid-release coupling.
- ⑥ Rubber-mounted motor suspension prevents any vibration.
- ⑦ Cable may be inserted from three different directions.
- ⑧ Field coils impregnated with special resin.

The colour of the KaVo Universal Motors is „Standard Grey“ according to RAL7001. On account of the moulded plastic material used for the housing, special colours can only be supplied in the case of fairly large orders and at an increased price.

The KaVo Foot Control

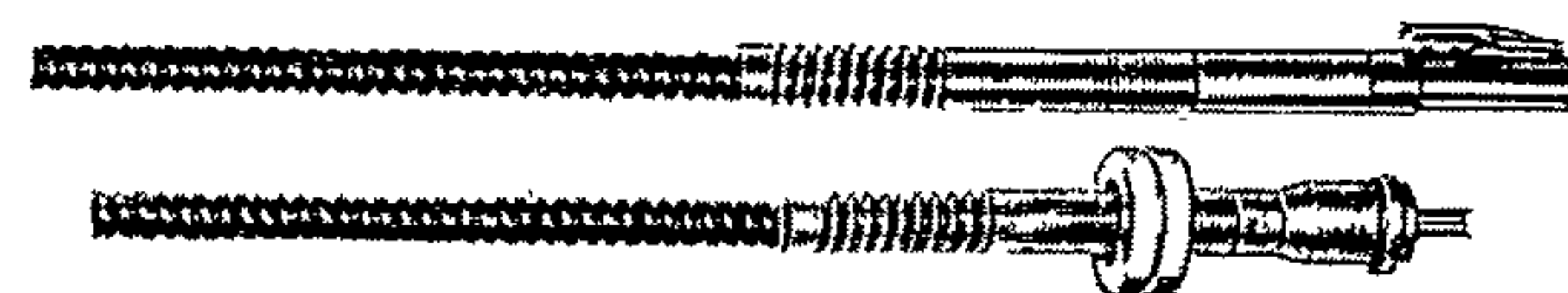
switches the KaVo Universal Motors on and off. With it the speed of the motors can be regulated in five smooth steps up to the final speed.

Special designs for motors and starters on request.

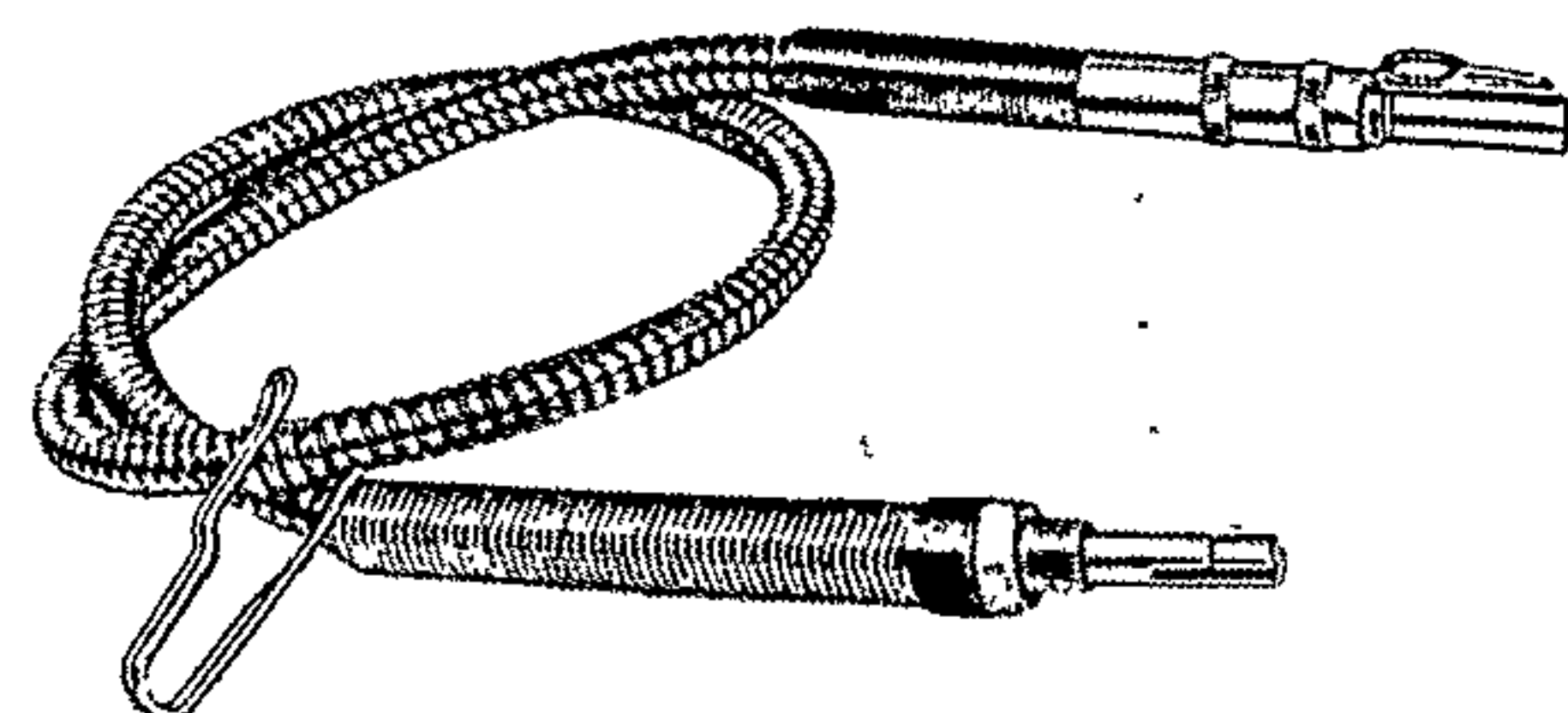


Radio and television suppression in accordance with VDE 0875

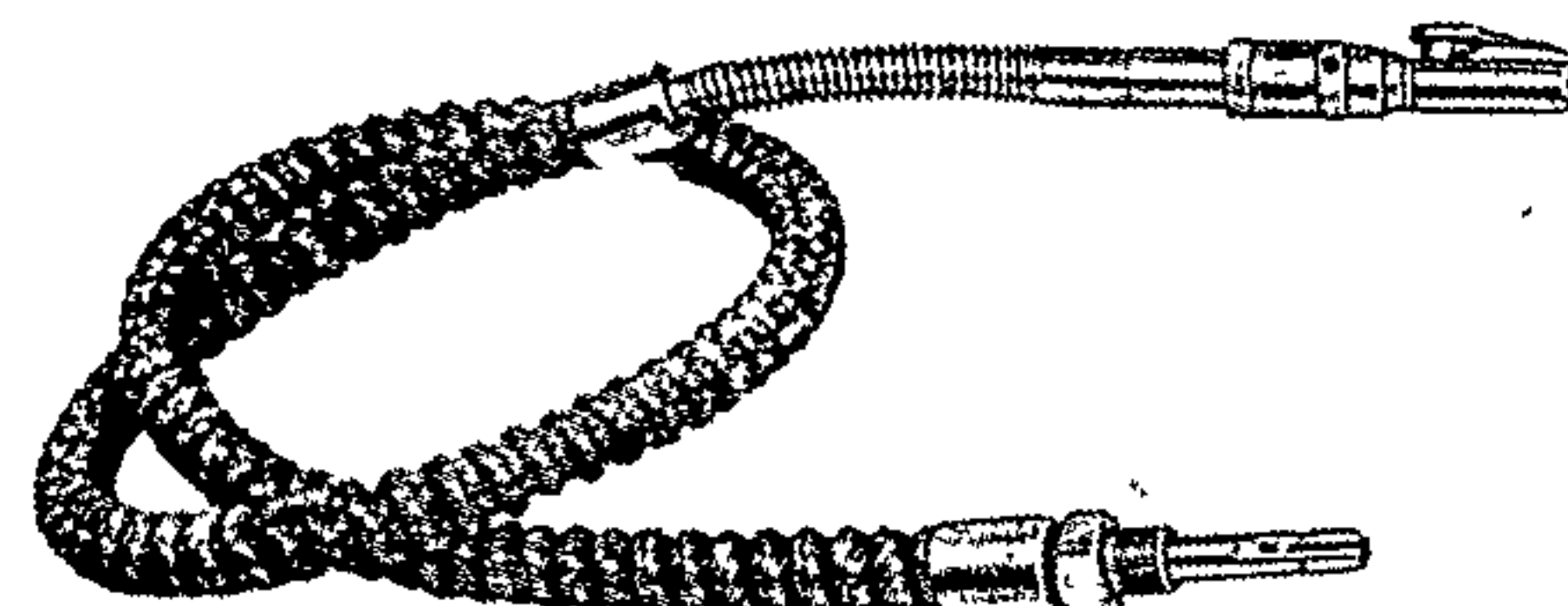
Figure 56.



Cable arm 380
for lab. motor 550/550 A
with plastic sheath



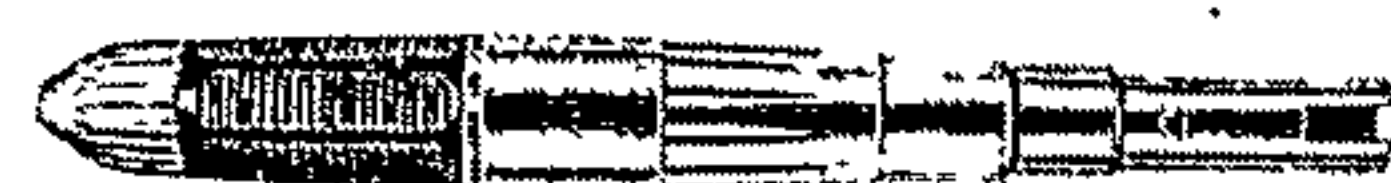
Cable arms 357/357 T/359/359 T
with metal sheath



Cable arms 356/356 T/374/374 T
with plastic sheath



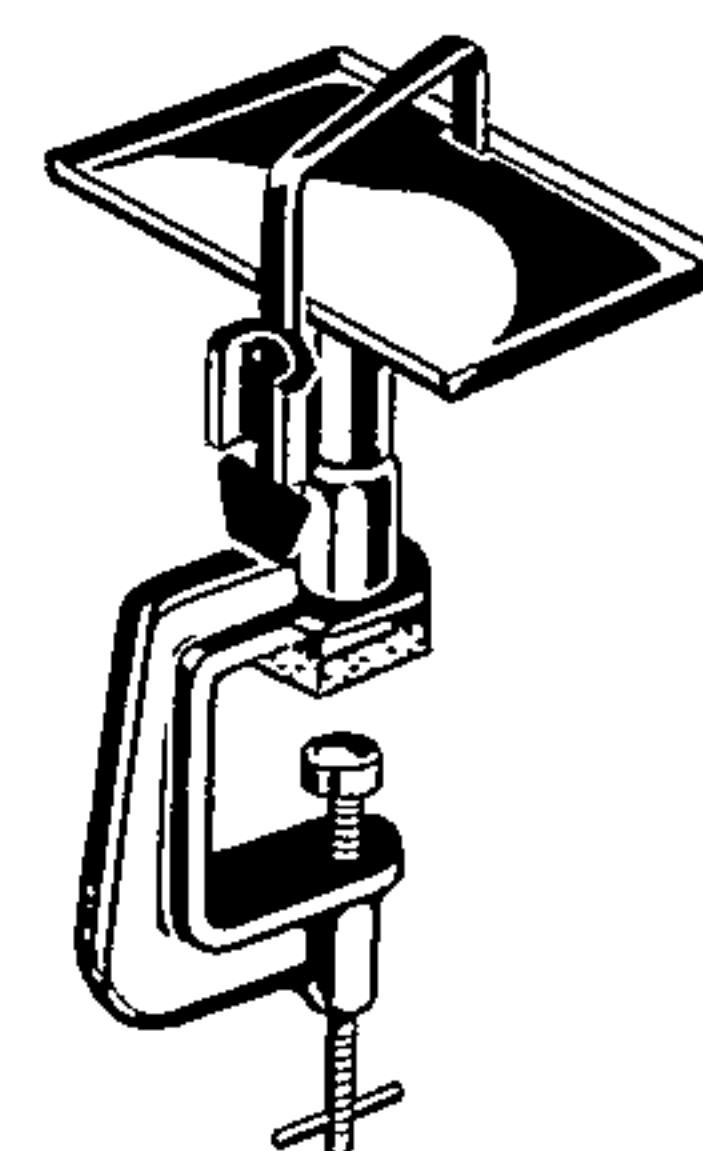
Laboratory handpiece
288



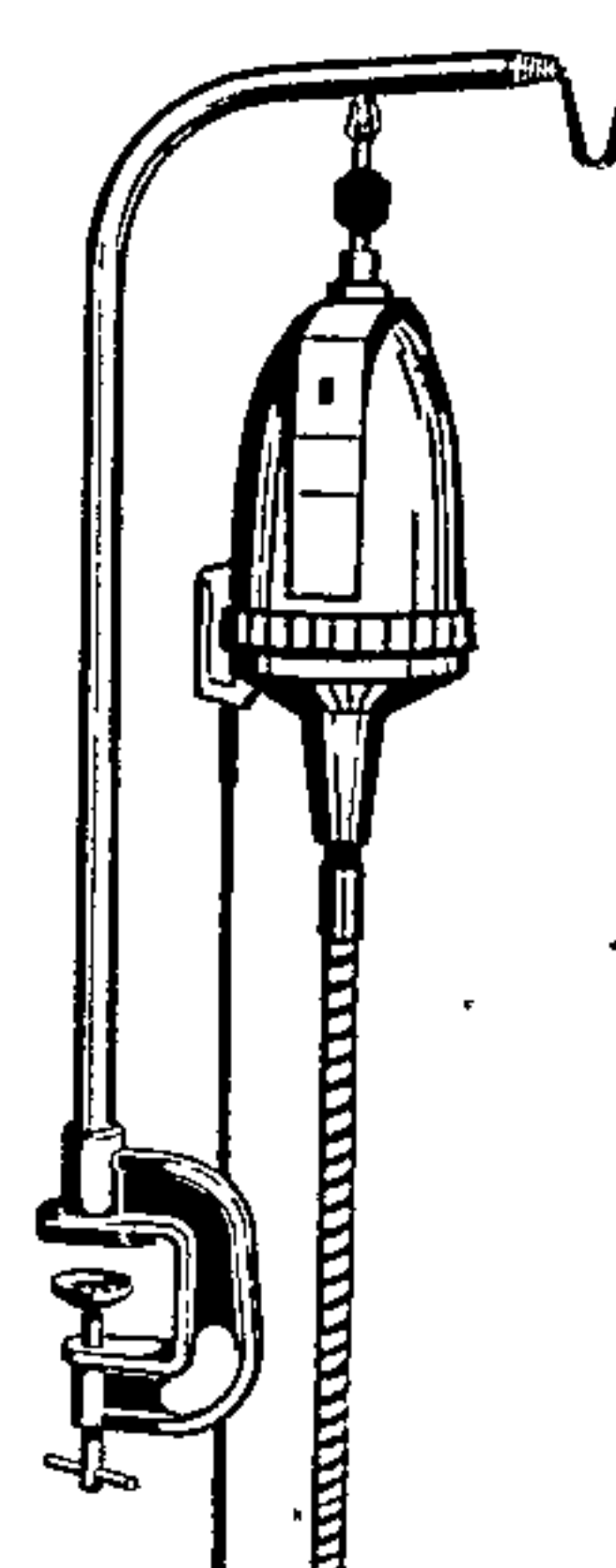
283/283 A



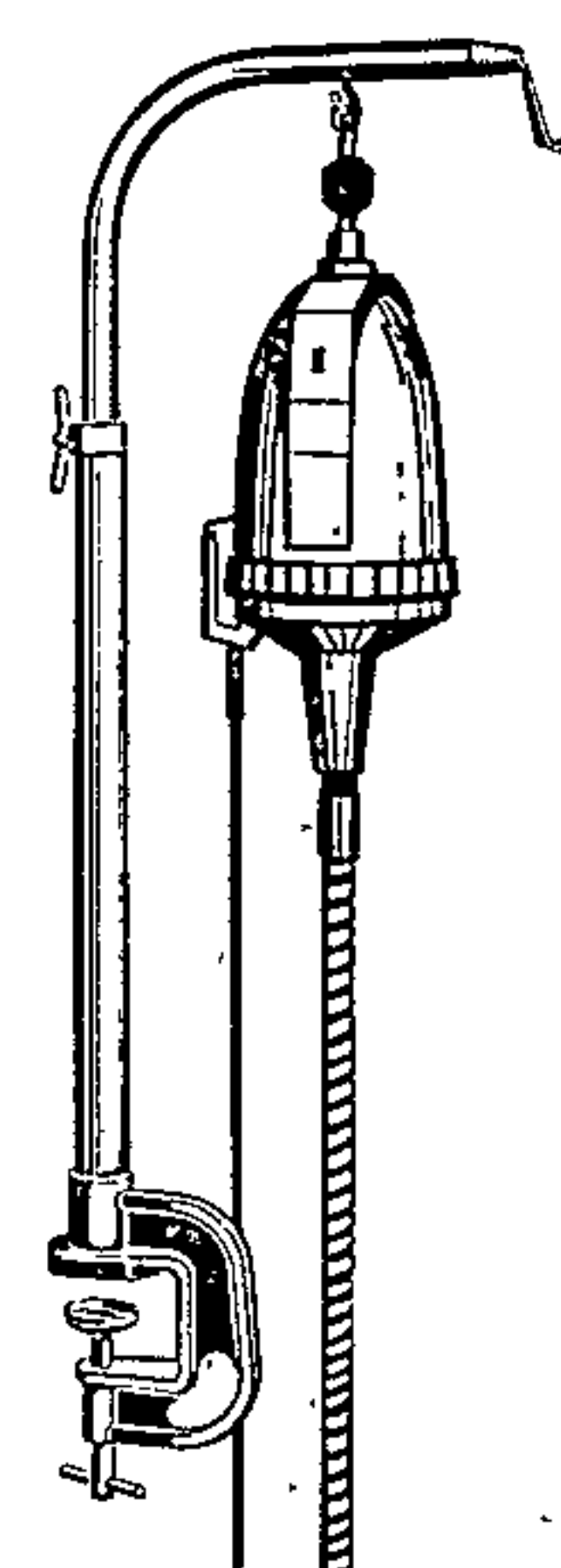
277



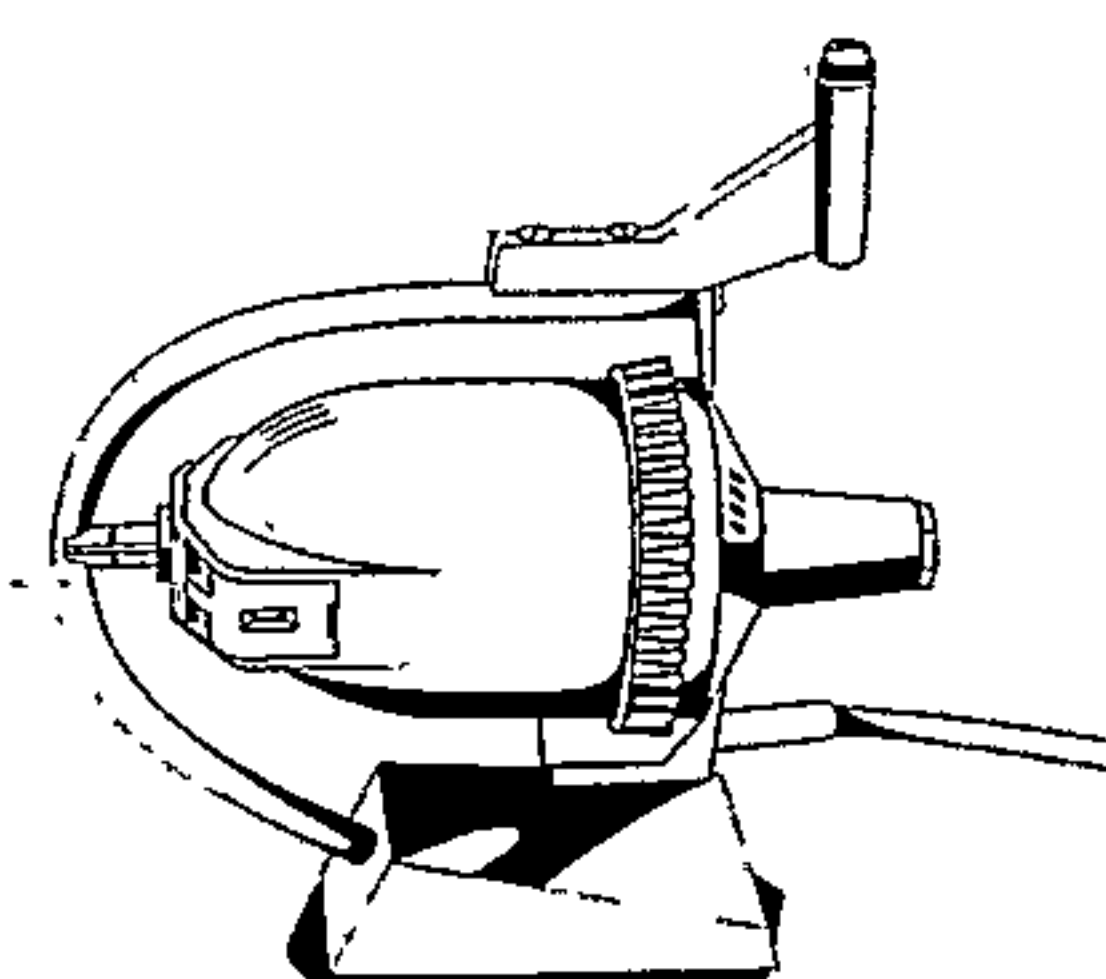
Bench stand 5020
for lab. motor 550/550 A



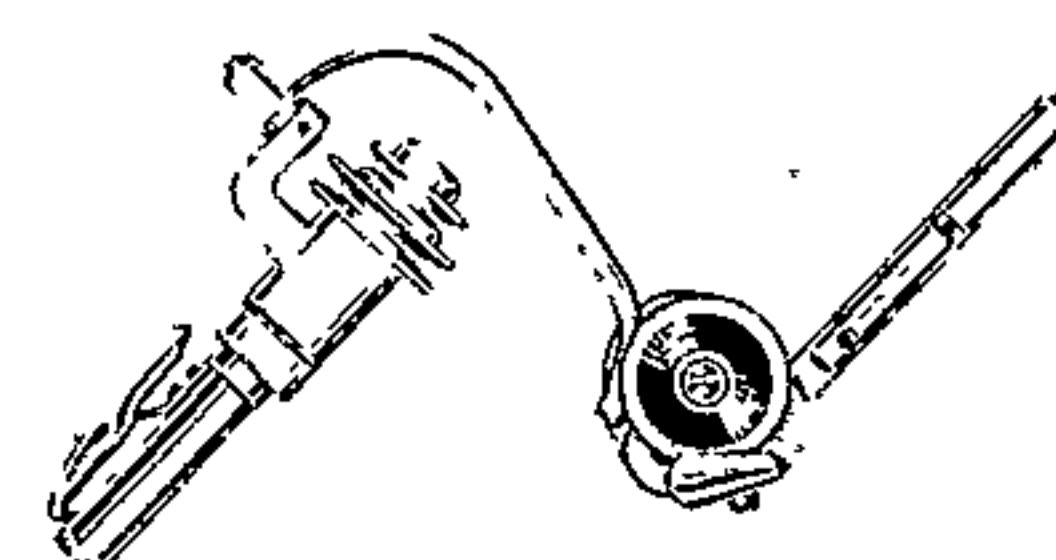
Bench stand 5003
with screw clamp



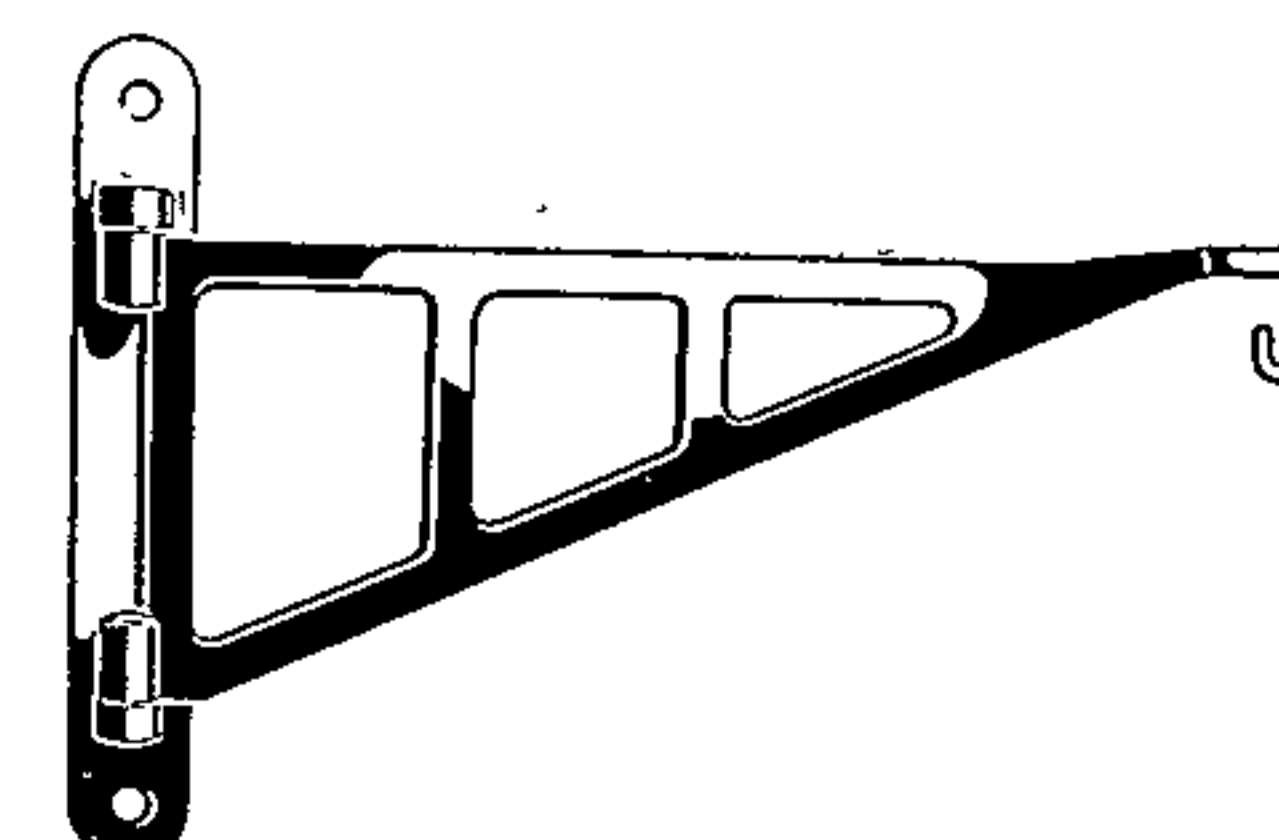
Bench stand 5003 A
with screw clamp,
height adjustable



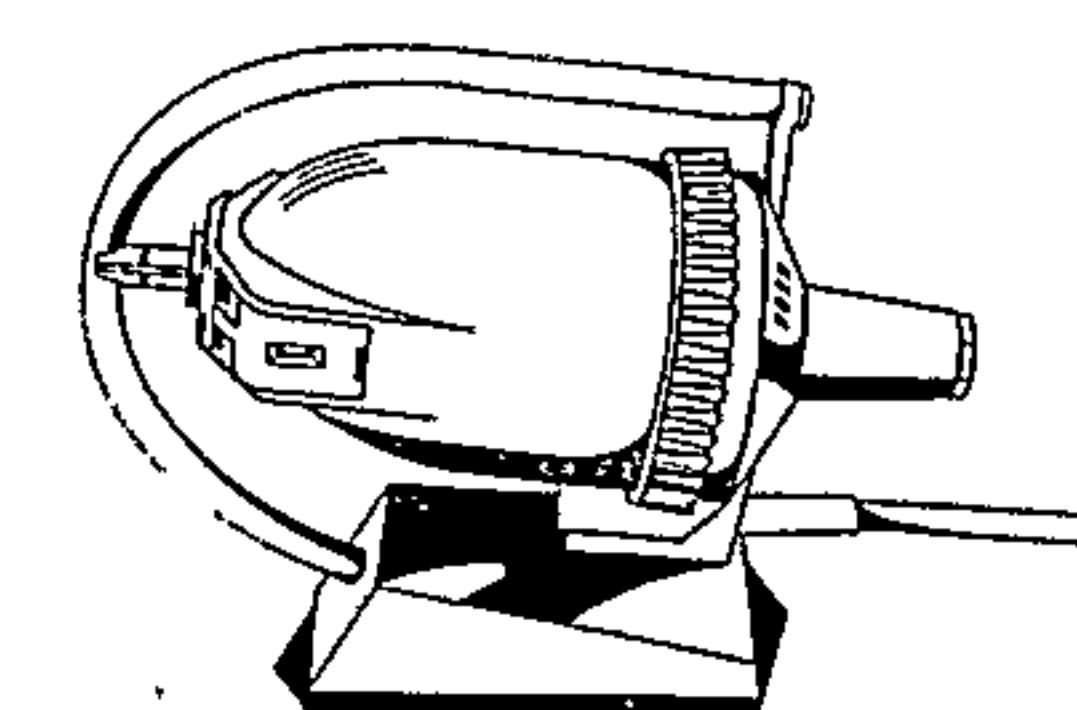
Horizontal suspension 5014
for Doriot all cord arm



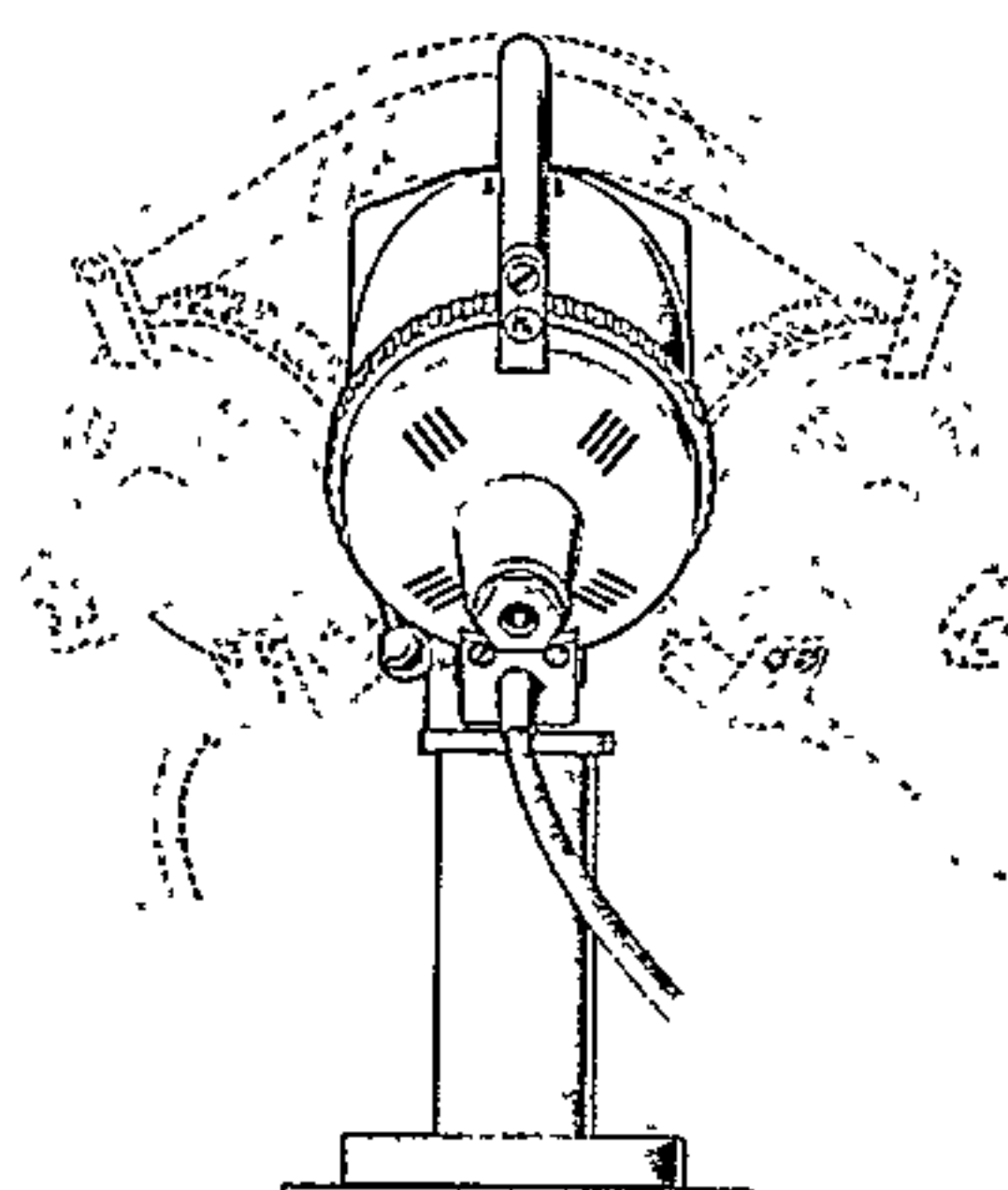
High speed wrist slipjoint 426



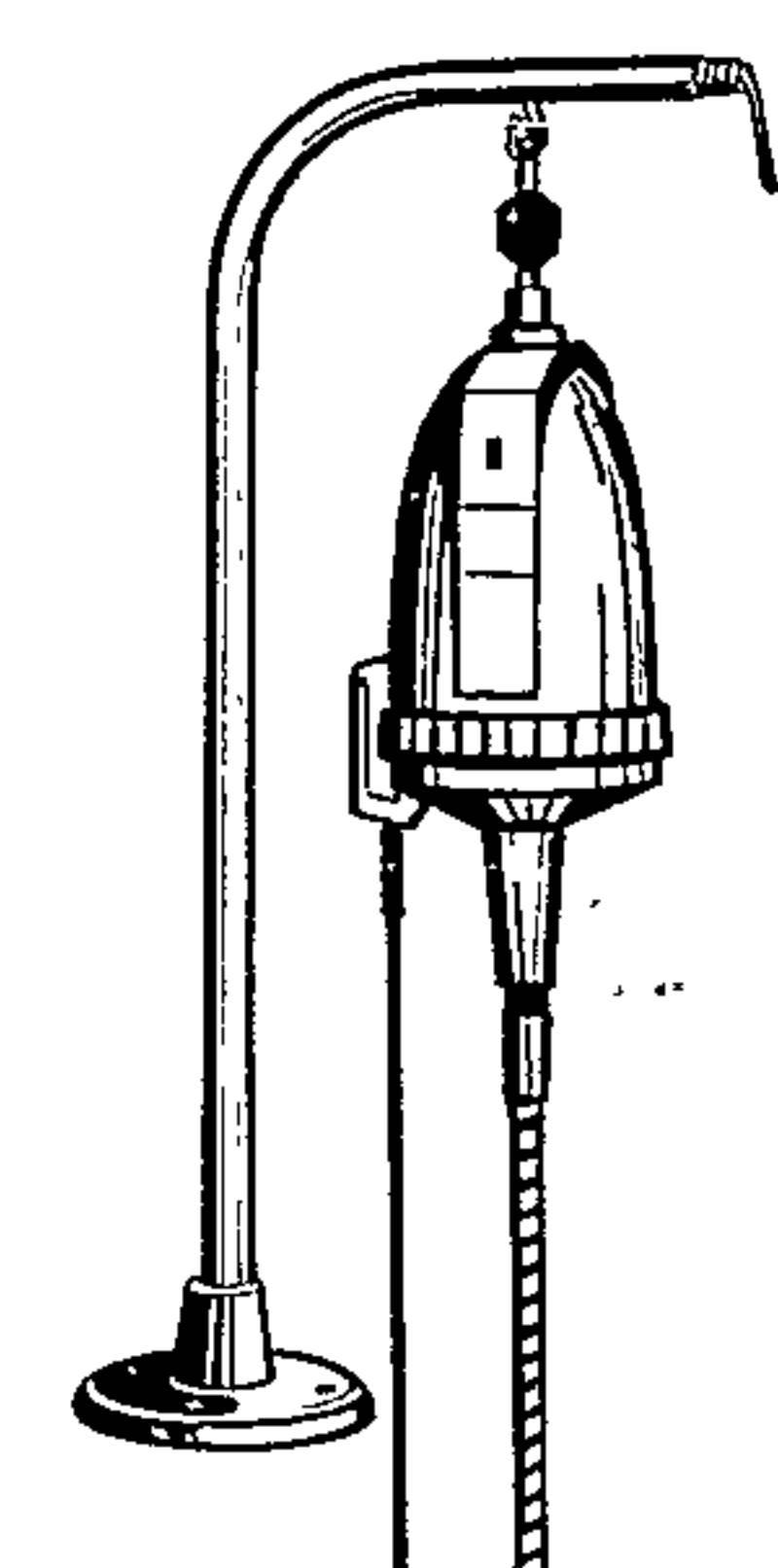
Wall bracket 5001



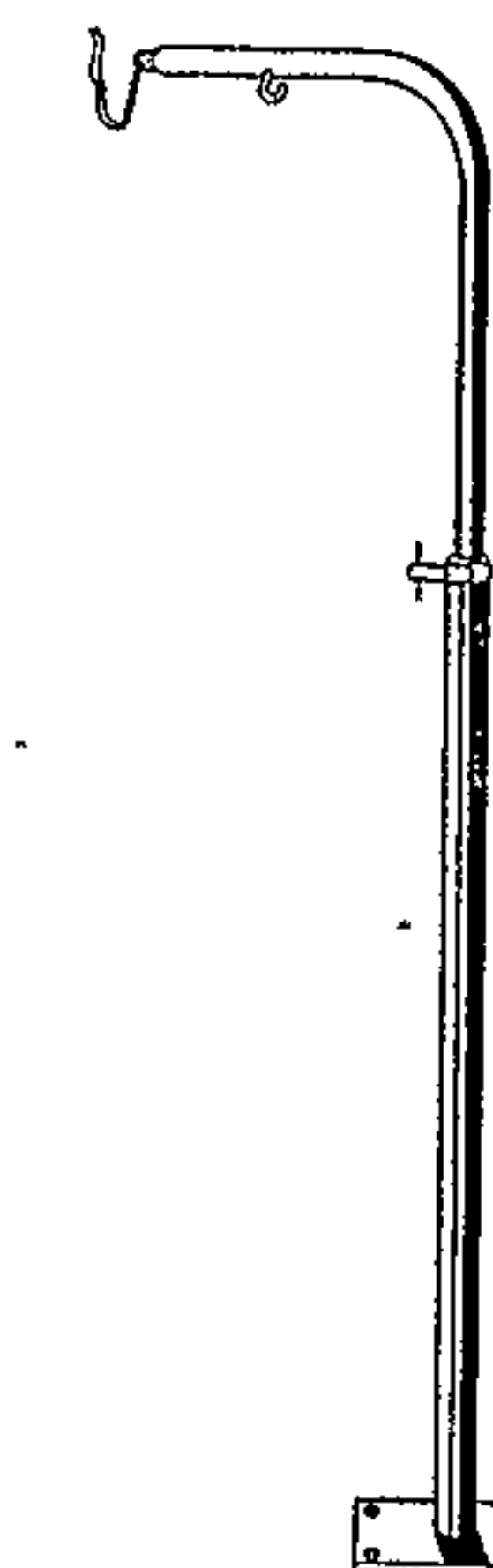
Horizontal suspension 5005



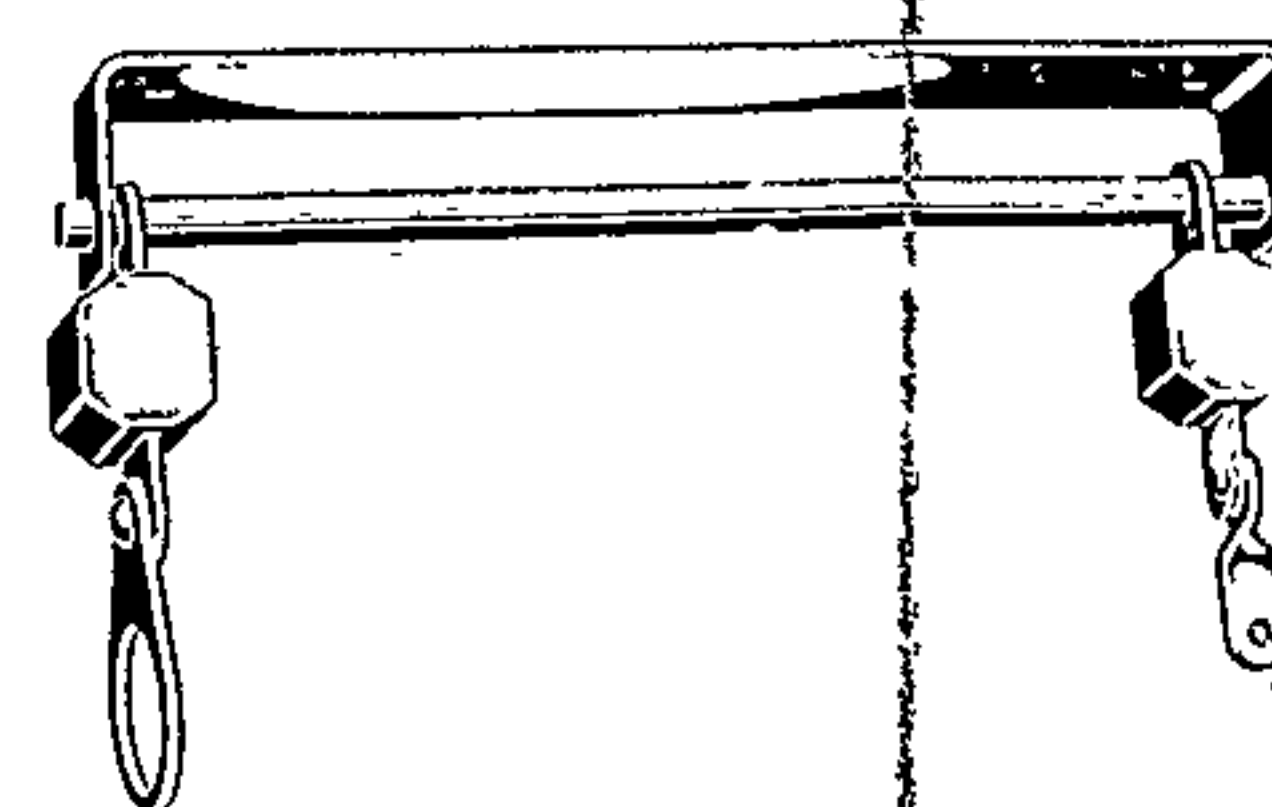
Bench stand 5025
rotatable and tiltable



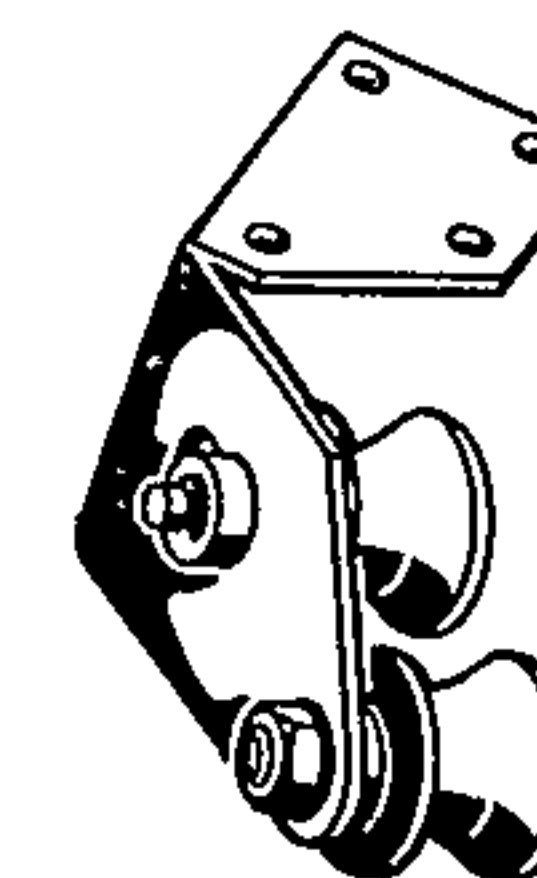
Bench stand 5004
with base



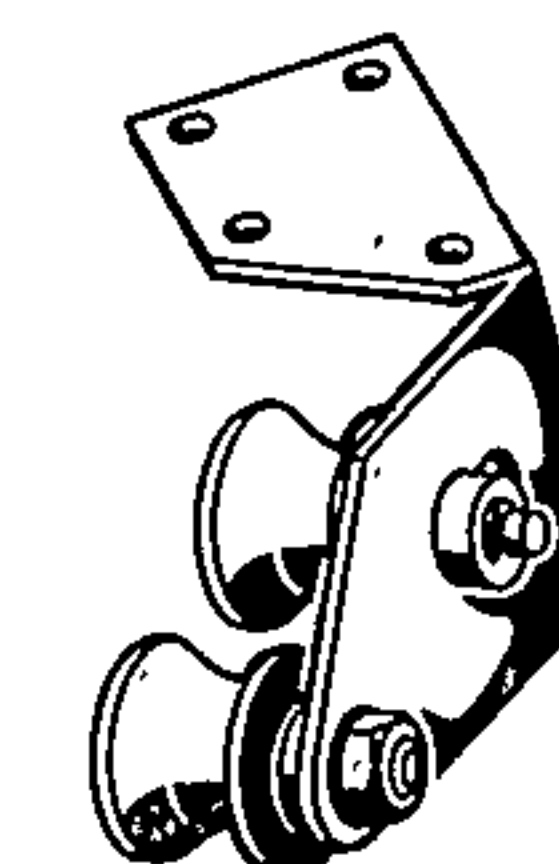
Bench stand 5004 B
with base,
height adjustable



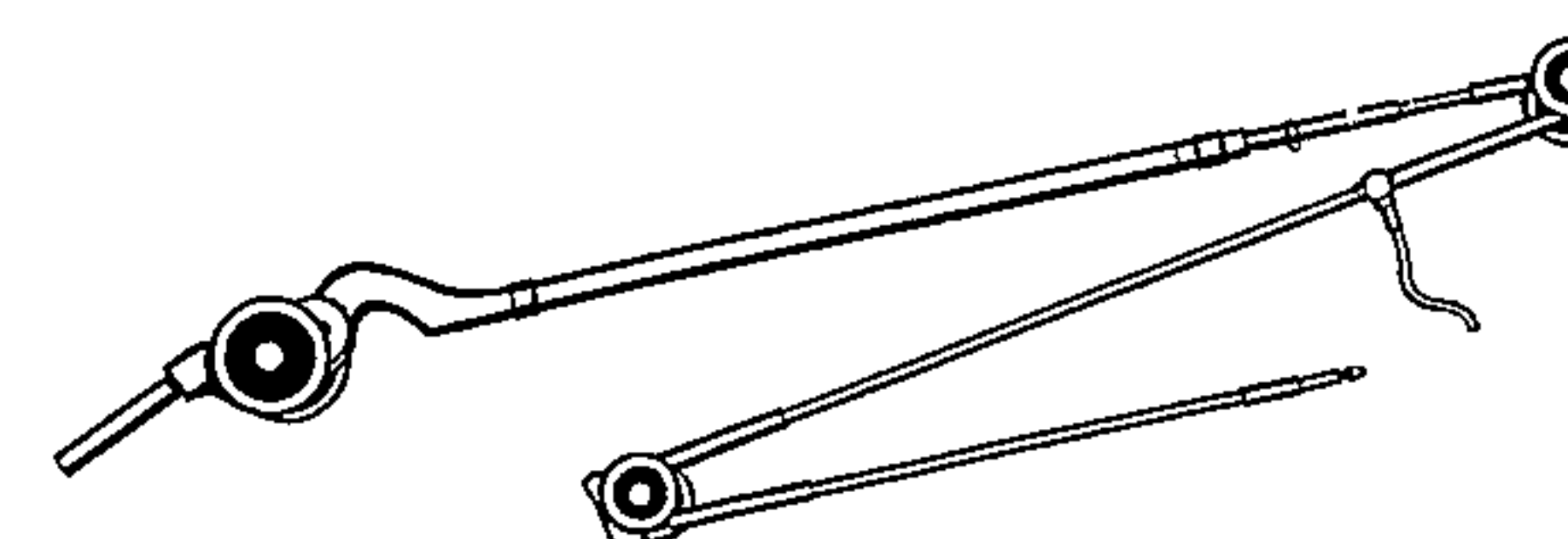
Suspension under-bench 5007



Cable guide 5015
for right hand



Cable guide 5016
for left hand



Doriot all cord arm 427

Sterilizers: The one in most common use is the Vauxhall or Hecla type of boiling water sterilizer shown in Vol.2, Plate 28.

Figure 58 also shows the "Technosteril" hot oven sterilizer, this is shown in Vol.2, Plate 27.

Figure 59 shows a fully automatic autoclave, the "Aesculap - 420". This is shown in the R.A.A.F. mobile dental clinic, Vol.2, Plate 71.

Figure 60 shows a "Betaduplex-Aesculap" sterilizer that can use either hot air or boiling water to sterilize.

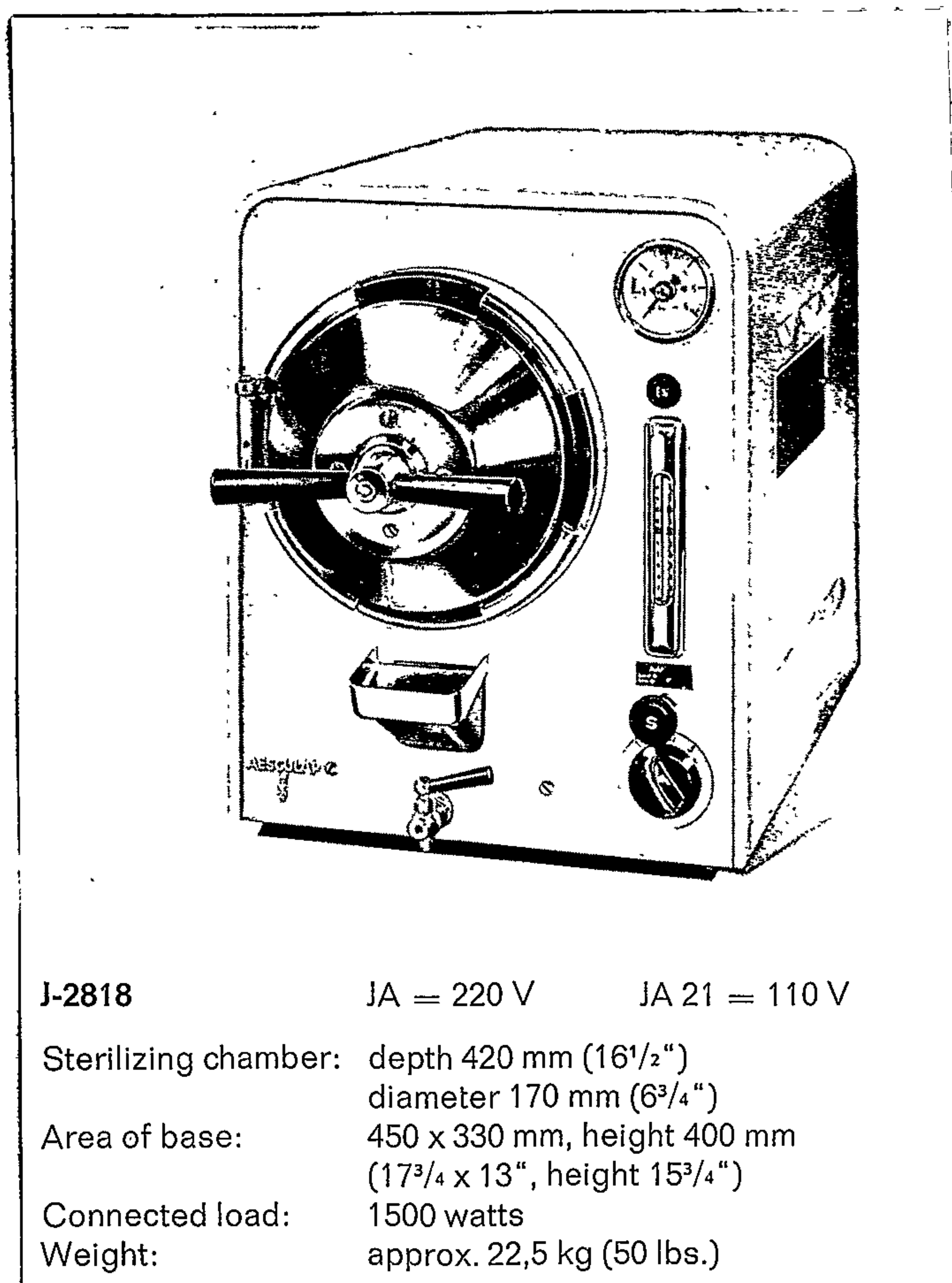
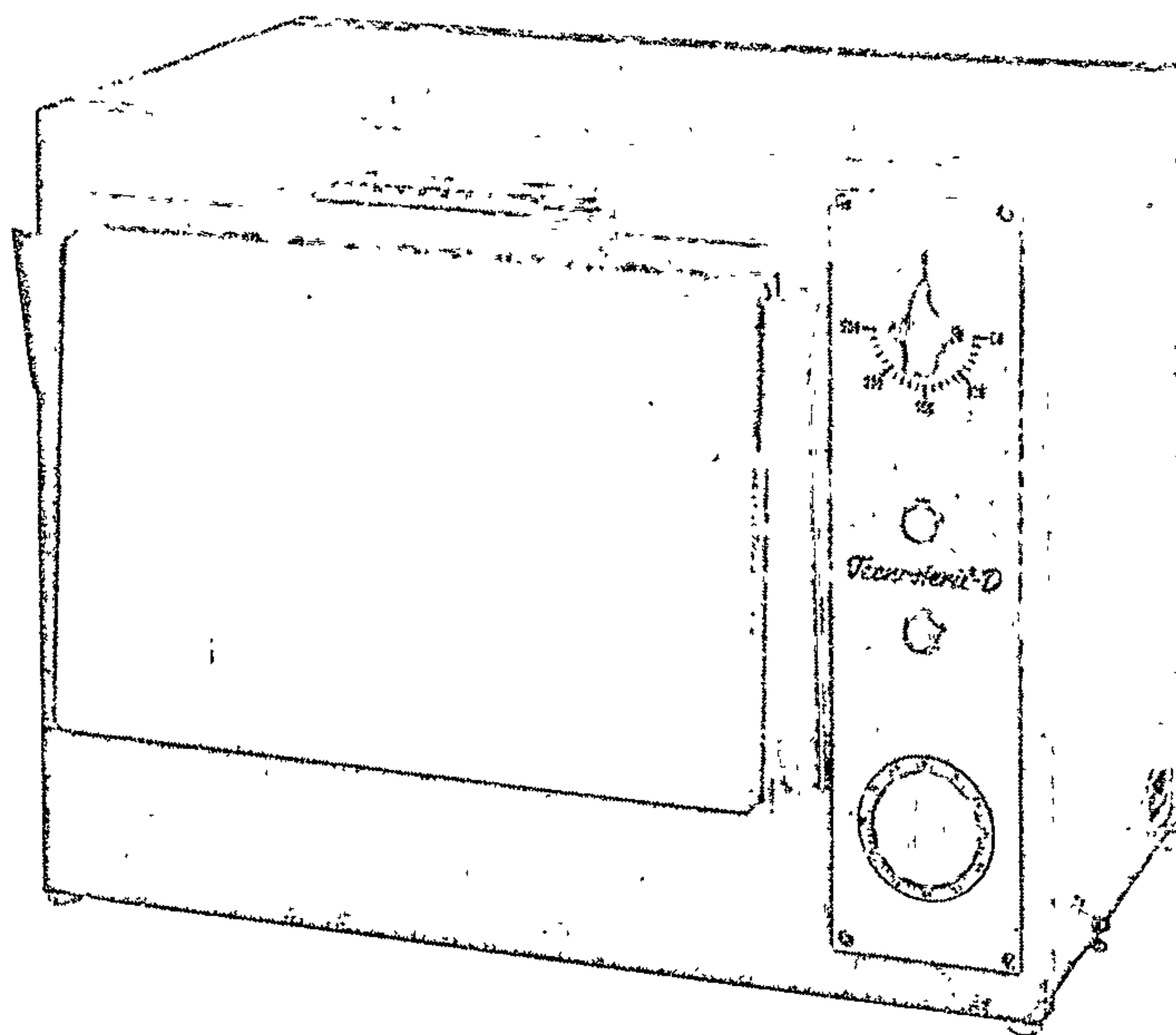


Figure 59.

TECNOSTERIL[®]

Sterilizzatrice a calore secco (220°) per strumentario e siringhe



Mod. « D »

dimensioni:

utili cm. 33 x 25 x 20 h

ingombro cm. 50 x 30 x 37 h

consumo W 500 - V 220

Figure 58.

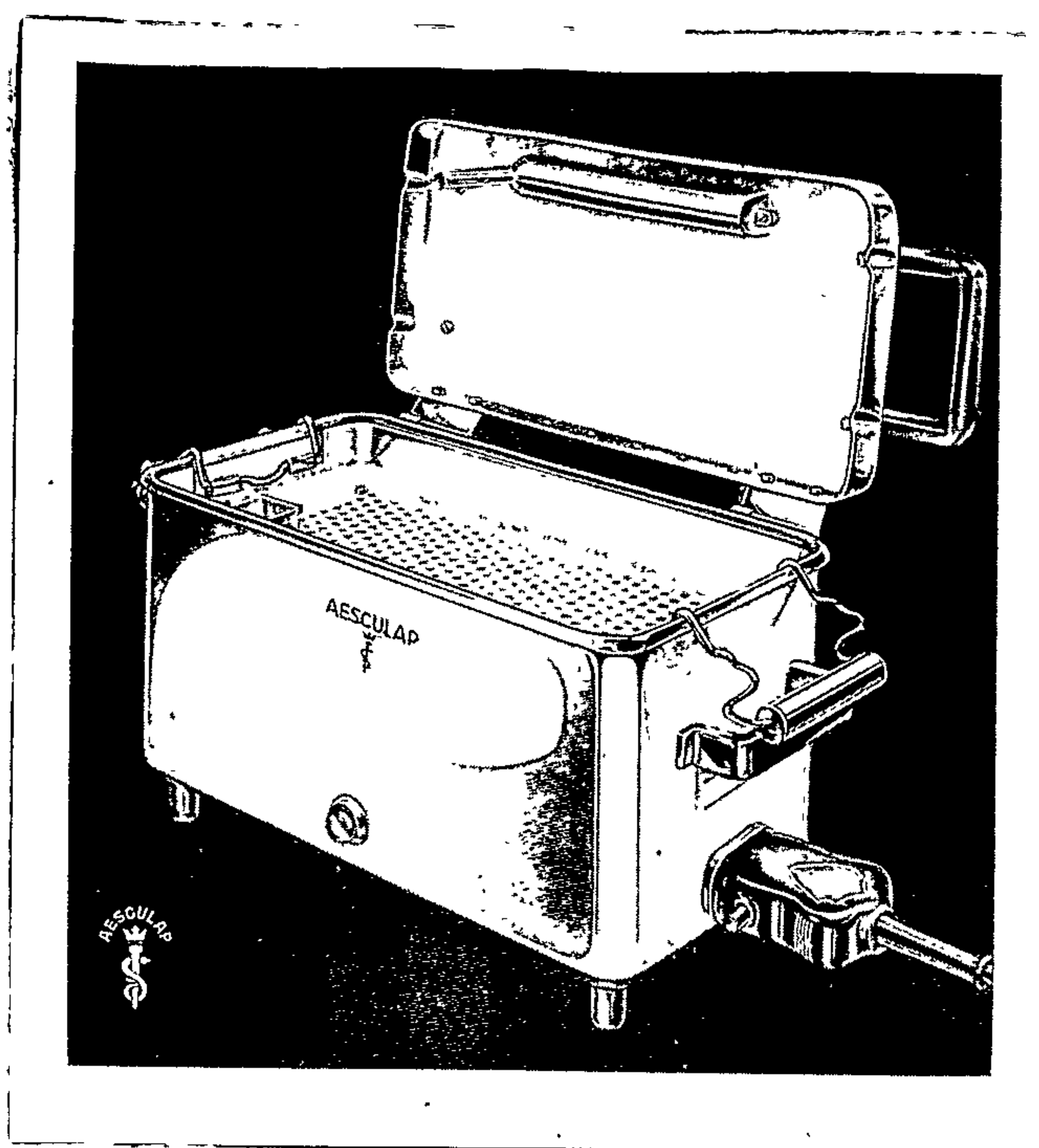


Figure 60.

Technical Data:

Cat. No.	Length		Boiler inside Width		Height		Maximum input wattage	Weight approx		Minimum filling		Maximum filling		Heating-up time to 180° C (358° F.)	Available for A. C. only
	mm	ins.	mm	ins.	mm	ins.		kg	lbs.	kg	lbs.	kg	lbs.		
J-822	220	8 11/16	120	4 3/4	65	2 1/2	550	2.7	5.9	0.3	.7	0.7	1.5	approx. 30-50 Mins. according to filling	110 or 220 Volts
J-828	280	11	140	5 1/2	75	3	680	3.7	8.14			0.9	2		
J-834	340	13 3/8	160	6 5/16	90	3 1/2	950	5.3	11.66			1.3	2.9		
J-842	420	16 1/2	180	7 1/16	105	4 1/8	1250	7.9	17.38			1.8	4		220 Volts only
J-850	500	19 5/8	200	7 7/8	125	5	1800	11.5	25.36			2.5	5.5		

Other mains' voltages can be accommodated at extra cost, but only up to 10 Amps.

Always state the voltage required when ordering.

The special enamelled finish of the sterilizer casing is resistant to shocks and scratches, as well as to continued exposure to temperatures of up to 200° C and all the common antiseptic solutions and cleaning agents.

Table 17.

Surgical Aspirators: H.I.Clements of Sydney, manufactures a safe, strong, portable, flameproof suction unit. This is shown in Figure 61.

Other portable types, such as the "Rotobyne" are shown in Vol.2, Plate 45.

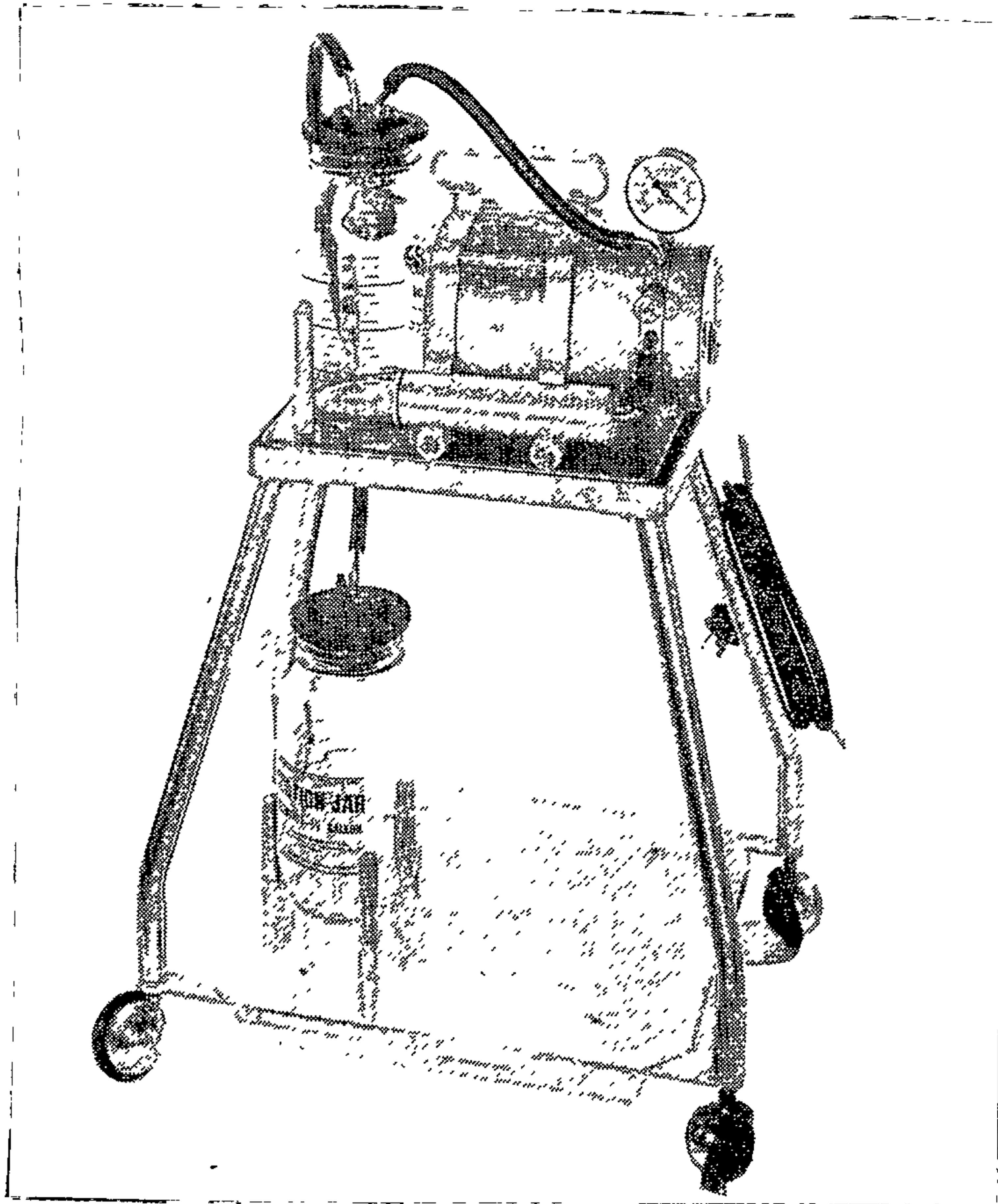


Figure 61.

iii) Costing: A cross-section of dental materials and equipment has been obtained and costed as to 1 July 1972. These prices include sales tax and duty:-

Surgery Equipment

Unit, W.G Challenger with counterpoised arm	
Kerr Electro-Torque System	
High Speed Airline	
Hanau Syringe	\$1,973.00

Handpieces

Ash Air Bearing	183.00
Kavo Air Bearing with spare head	420.00
Borden '70 with spare head	277.00

High Velocity Evacuators

W.G.Separator Box fitted	175.00
High Velocity Exhauster with Relay	306.00
Rotobine Compact Mobile	330.00

Operating Lights

Pelton & Crane Light Fantastic	360.00
Yoshida Galaxy	333.00
Correlites Ceiling Mounted 2	184.00

Chairs

CAD SD 2	2,100.00
Yoshida Telstar	1,534.00

Cabinets

Cabinet Modular Basin & Bench	200.00
" " Instrument	173.00
" " Assistant	173.00

Sterilizer, Dry Heat

Memmert	175.00
---------	--------

Stool, Operating

Bendix	176.00
--------	--------

<u>Surgical & Operative Instruments</u>	500.00
---	--------

Typical Example of Surgery Cost

1 x Unit, W.G.Challenger E/T	\$1,973.00
1 x Ash A/B Handpiece	183.00
1 x W.G. High Velocity Separator, fitted	175.00
1 x W.G. " " Exhauster, fitted with relay	306.00
1 x Light, Operating, Pelton & Crane	360.00
1 x X-Ray Philips, Oralix, United Mounted	780.00
2 x Correlites Ceiling Mounted	184.00
1 x Yoshida Telstar Chair	1,523.00
1 x Cabinet, Modular, Basin & Bench	200.00
1 x " " Instrument	173.00
1 x " " Assistant Mobile	173.00
1 x Sterilizer, Dry Heat, Memmert	175.00
1 x Stool, Operating, Bendix	176.00
Surgical & Operative Instruments	500.00
	\$6,881.00

Laboratory

1 x Compressor, Air VKS Silent	\$ 362.00
1 x Lathe, GMF	92.00
1 x Furnace, Burnout	158.00
1 x Mobile Hanging	130.00
1 x Laboratory, Instruments & Appliances	160.00
	\$ 902.00

COST OF SELECTED DENTAL MATERIALS

31st December - 1970 - 1

ITEM	COST		COST	
	31st December, 1970		31st December, 1971	
Alloy Silver Dentalloy	oz.	\$ 4.95	\$	4.60 oz.
Mercury G. & G.	lb.	9.75		6.61 lb.
Anaesthetic Xylocaine 2.2.cc cartridge	100	6.00		6.90 bx.
Porcelain Filling Material	box	4.35		5.10 Pdr/Liq.
Composite Filling Material (Concise)		59.00		41.00 bx.
Gold Inlay GS.	2 dwts.	4.83		6.81 2 dwt.
Impression Materials:				
Alginate Zalgan (60)	Box	4.48		9.85 bx.
Paste S.S. White	Box	3.65		3.90 bx.
Rubberised Permlastic	Box	8.90		8.90 bx.
Burs Steel Plain Ash	gross	12.69		15.00 gross
Burs Tungsten Carbide F.G.Ash	each	1.38		1.41 ea.
Teeth - Porcelain Anteriors (Perceptor)	Set of 6	3.15		3.39 set
X-Ray Film Kodak DF54		2.85		2.85 bx.

Source: J.T. Jennings

CHEMICAL FEEDERS: With fluoridation of water supplies now a proven public health measure, consideration should be made for portable chemical feeders to supply fluoridation to small towns of say 500 people or to transient communities that have a requirement for this type of equipment.

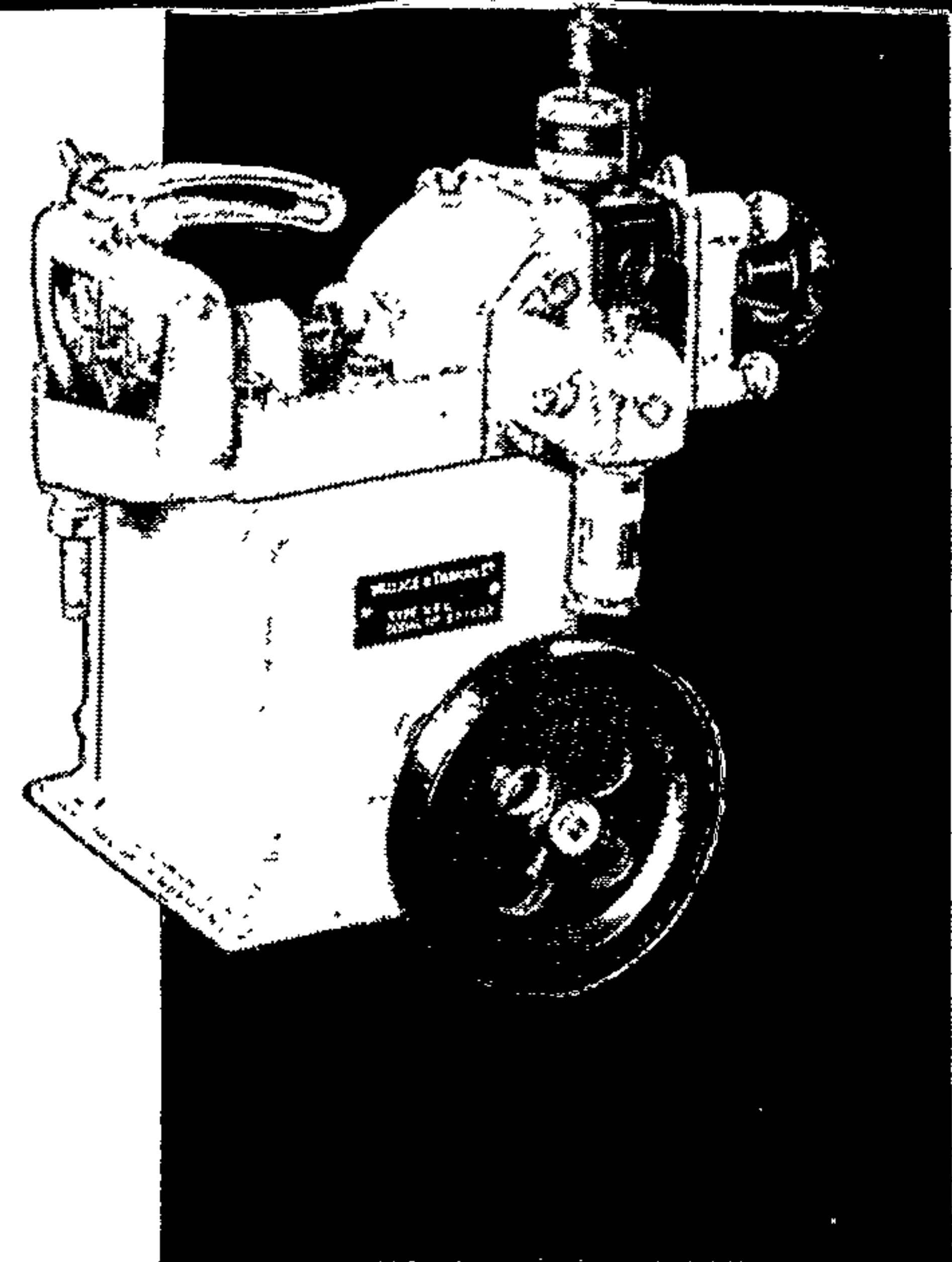
Wallace and Tiernan, Sydney, have supplied a chemical feeder to Qantas for use on the "Jumbo" jets, to chlorinate the water supply, in their aircraft, for up to 500 people. This portable feeder can be used to fluoridate a small town or transient community. Vol.2, Plate 58.

Three types of chemical feeders that can be used to provide this type of fluoridation are shown in Figure 62.

BELT OPERATED-Model BA-1021

(HB, HBM, HBMP)

This model is designed for installations where no electricity supply is available or where D.C. current only is used and a D.C./A.C. converter is not considered practicable. When the drive is taken from the main pumping unit, the feeder will vary the chemical dosing in proportion to the rate of pumping. It is almost identical to the electrically-operated model, but the drive motor is replaced by a 5 in. pulley; it remains only for the customer to provide a means of driving this at between 280 and 300 r.p.m. with the 10 ft. of belt provided. The pulley is designed for a $\frac{1}{4}$ in. diameter circular section belt. In the same manner as with the electrically-operated model, the maximum capacity may be varied manually over a range of 36:1.



WATER OPERATED-Model A-415 HWM

This feeder is particularly suited, as a portable unit, for emergency work and for mains sterilisation.

The operating power is derived entirely from the pressure in the main into which the chemical solution is being injected, the same source providing also the balancing water supply. This supply, which must be between 10 and 125 p.s.i., is applied to a power diaphragm to operate the mechanism, the suction stroke being under spring action. The output is controlled over a 12:1 range by means of a valve fitted in the water supply line to the power diaphragm to vary the number of pumping strokes per minute. Since the suction stroke is achieved by spring action, it is extremely rapid, occupying only a fraction of the time taken by the pumping stroke, so that the application of the solution is, for all practical purposes, continuous. The maximum water consumption for both balancing and operation is 0.4 i.g.p.m.

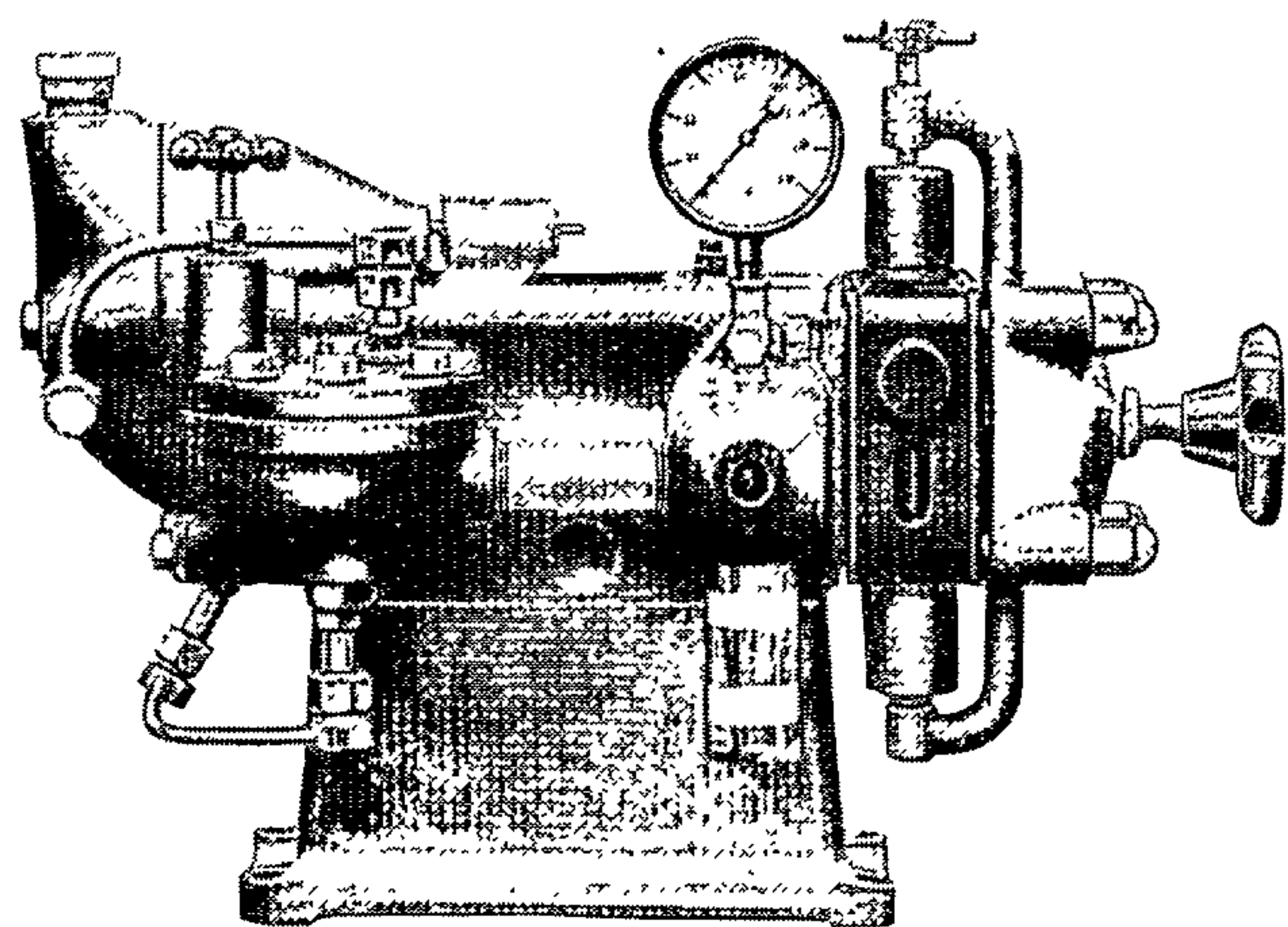
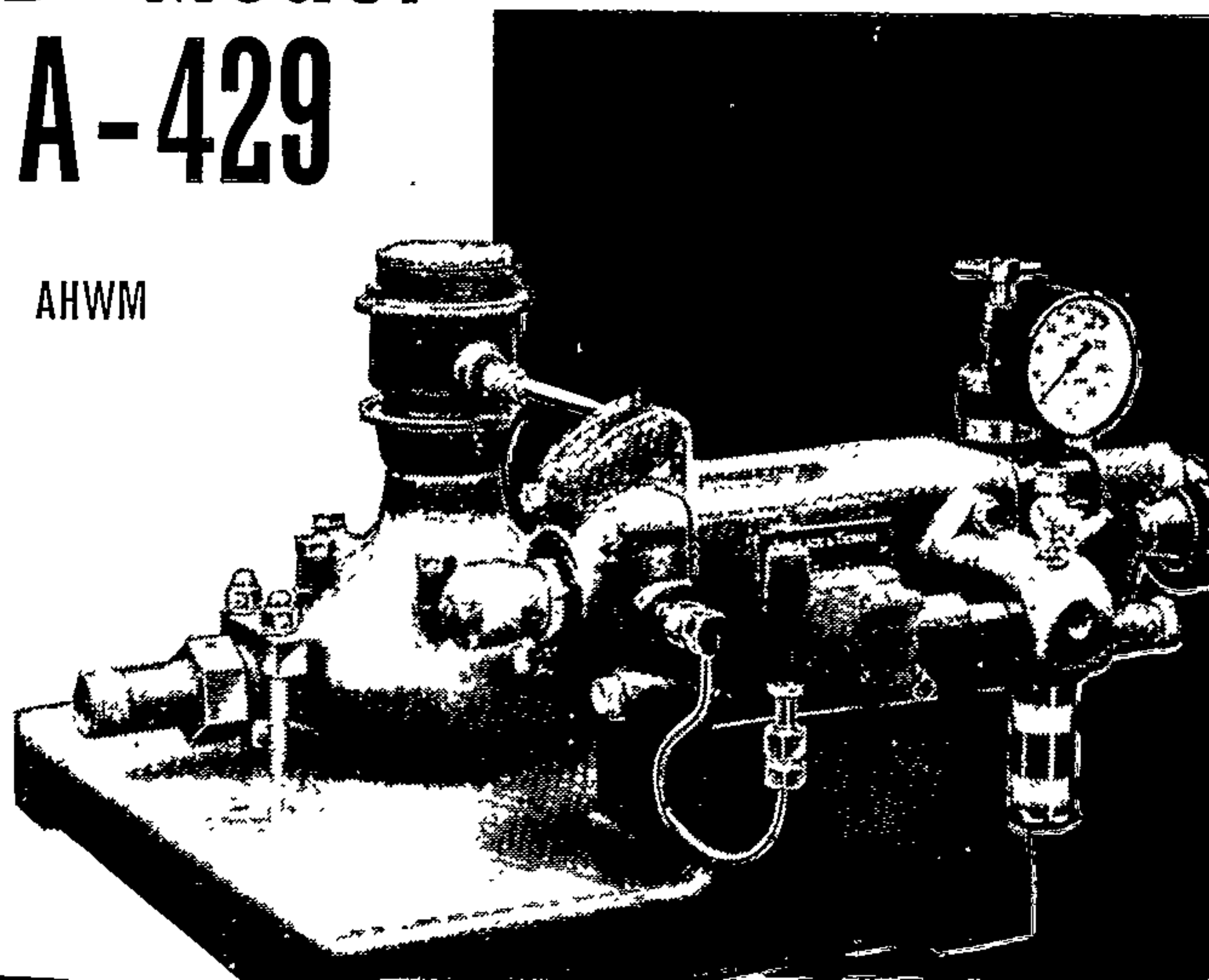


Figure 62.

AUTOMATIC WATER OPERATED-Model A-429 AHWM

This feeder meets the demand for a pump which will proportion the dose of chemical to the rate of flow in the main. Operation is similar to the type HWM, but the rate of pumping and hence the rate of application, is directly controlled by a water meter installed in the main water line. This meter forms an integral part of the apparatus. Where the main flow is large, the meter may be connected into a by-pass round an orifice plate or partly closed valve in the main line, in which case the rate of application is still proportional to the main flow. The provision of the orifice plate or valve is not normally included in a quotation. The power required to operate the pilot valve, which initiates each pumping stroke, is negligible and derived via a specially shaped cam from the water meter, through a bevel gear unit. The pumping unit is also provided with a stroke control, which can be adjusted, whilst the unit is running, over a range of approximately 4:1. As with the type HWM, the operating water pressure must be between 10 and 125 p.s.i., the maximum water consumption is 0.4 i.g.p.m. and, since the suction stroke is very rapid and the delivery stroke relatively slow, a virtually continuous supply of chemical solution is delivered to the injection point.



9. DESIGN AND ENVIRONMENT OF PORTABLE EQUIPMENT

Engineering, manufacturing, advertising, and merchandising specifications have influenced dental equipment design. The resulting production of dental equipment does not always meet the operating needs of the dentist. If a piece of dental equipment is to be effective, it must be co-ordinated with all other equipment in the office. It would not be logical to design a dental unit independent of the dental chair, the dental operating stool, or the dental cabinet. All pieces of equipment must be part of a single concept since their design and function are interdependent. (53)

Figure 63 gives an example of basic equipment used in the 18th and 19th centuries in the U.S.A. (54) and is indicative of the outstanding advances made in modern dental equipment concepts.

The method of design that utilizes the human factor approach is used in the aircraft industry. The pilot is placed in an ideal position, the controls are designed and placed around him, then the fuselage and wings are built and finally a functionally efficient aircraft structure evolves. This method should be applied in evolving modern dental equipment. The prime object being prolonged comfort for the patient and an efficient position for the dentist. (55)

The dentist's efficiency in treating his patients is partly determined by the efficiency of his operating environment, particularly his instruments and equipment. Thompson has formulated 26 principles for the design of effective and time-saving dental equipment. (56)

- 1) Dental equipment must function efficiently to meet immediate equipment needs through all operating variables.
- 2) All component instruments must be immediately available to both dentist and chairside assistant during all operative variables.
- 3) Dental equipment should be designed to bring all component instruments, static instruments, and immediate operating supplies toward or away from the patient, whose operating posture remains almost constant in the centre of the operating ovoid. Vol.2, Plate 59.
- 4) A complete complement of component instruments should be included in the operating ovoid to serve the needs of the operating dentist.
- 5) Equipment in the treatment region should be inoffensive in appearance and as aesthetic as possible. It should contain, rather than merely support, as many dynamic instruments as possible.
- 6) Dynamic instruments should be accessible to the patient's mouth from the 5 o'clock to the 6 o'clock position.
- 7) Cords, hoses, and tubes attached to dynamic instruments should be as short, as light in weight, as torque-free, as bend-free as operating limits will allow during use.
- 8) Instruments, dynamic or static, should not be placed over the patient while he is in the dental chair.
- 9) Dynamic instruments should be so related to the dental chair that they go up and down as the dental chair is raised or lowered and slide back and forth in a horizontal position to accomodate operating variables.
- 10) Equipment design should, wherever practical, provide automatic activation and deactivation of dynamic instruments to eliminate manual switch manipulations.
- 11) The turbine variable foot control should be oriented

IN THE DAYS OF LONG AGO

On the first day of July, 1859, the Georgia Dental Association came into being; and to celebrate its centenary there was published a brief story of its growth and development. The following illustrations are among the many that accompany the text. We reproduce them because of their historical interest.

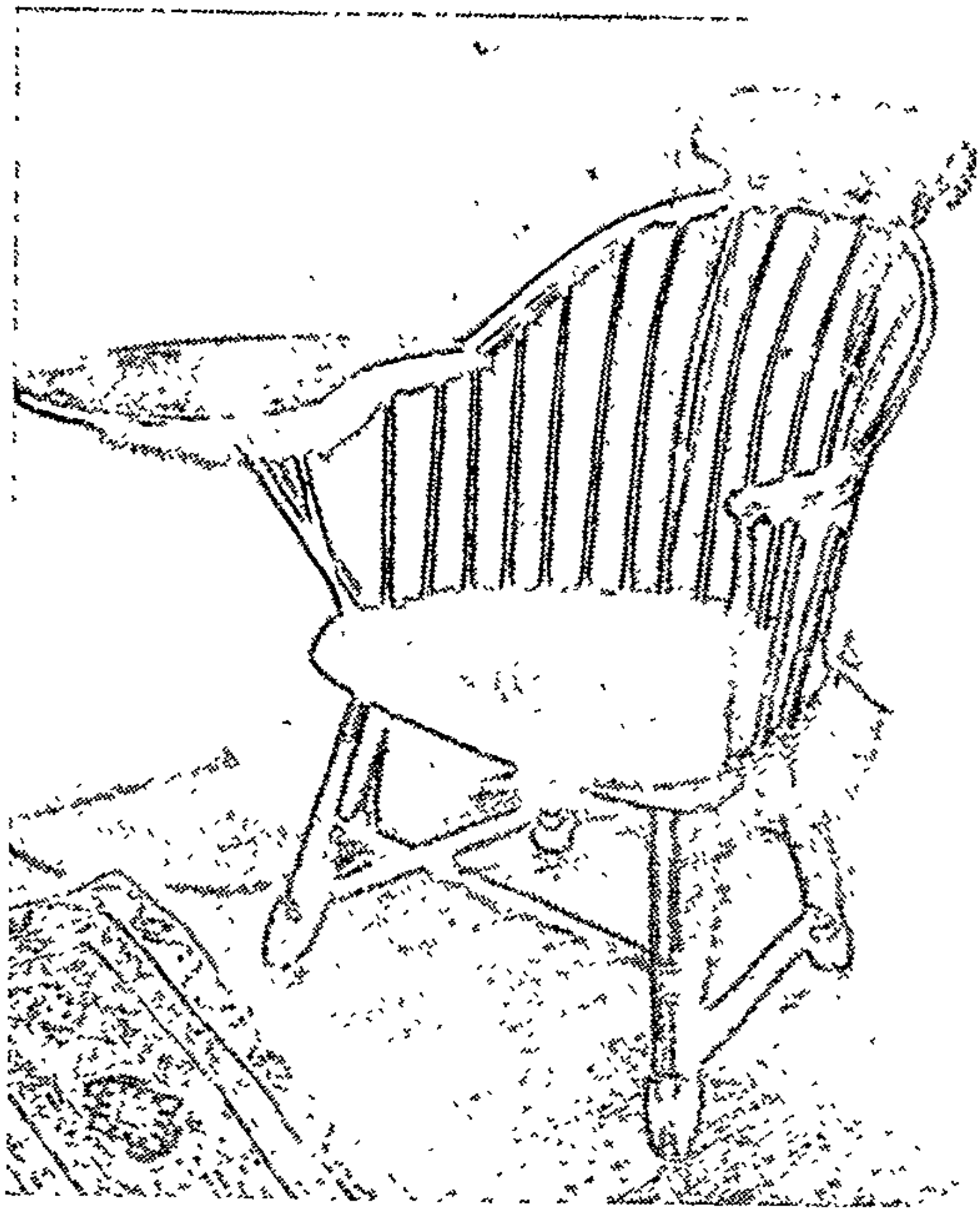


FIG. 1.—Oldest known dental chair in the U.S., used by Josiah Flagg from about 1790 to 1812.

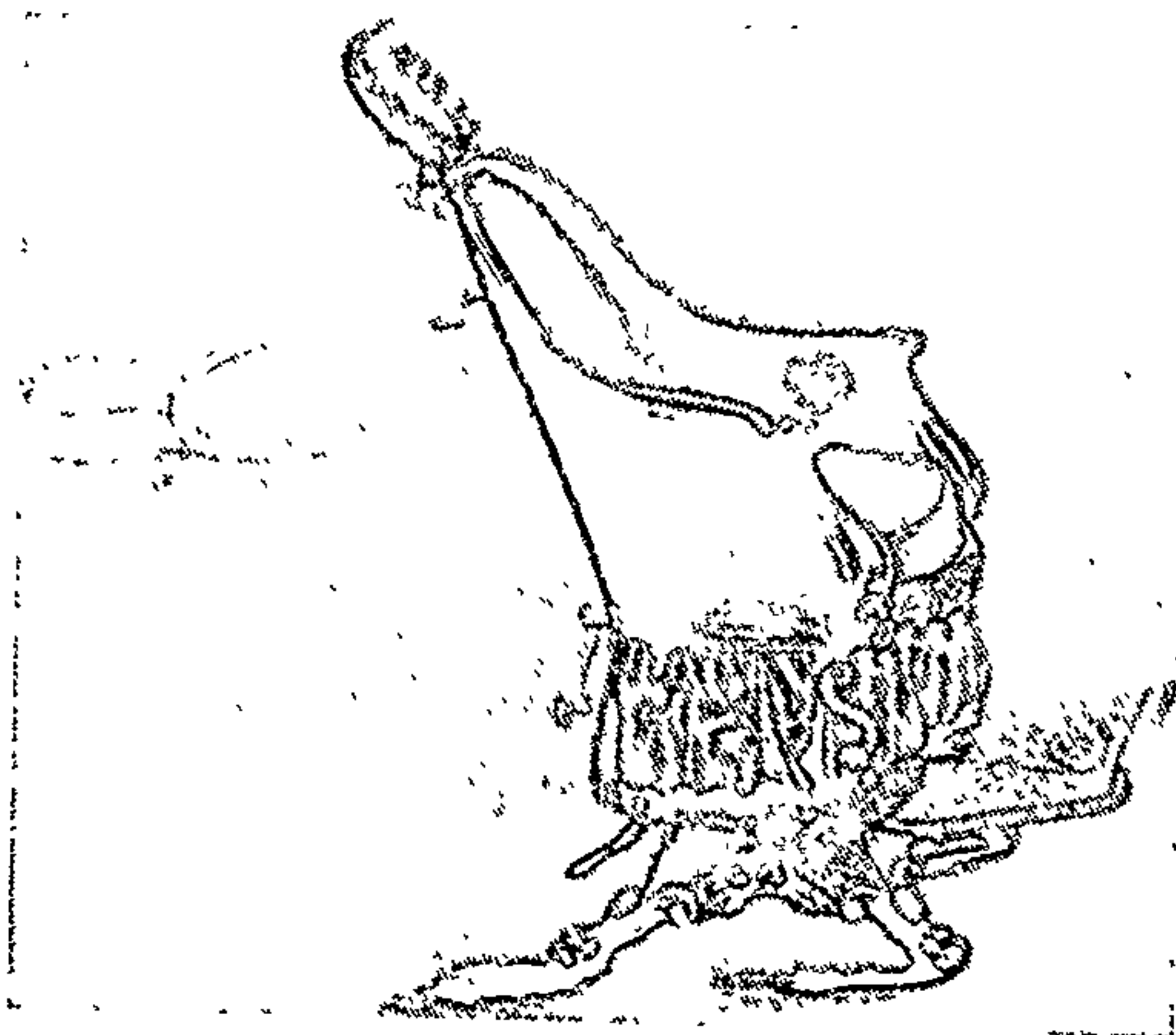


FIG. 2.—Perkins' Improved Dental chair, made of mahogany, sold for \$160 in 1867.

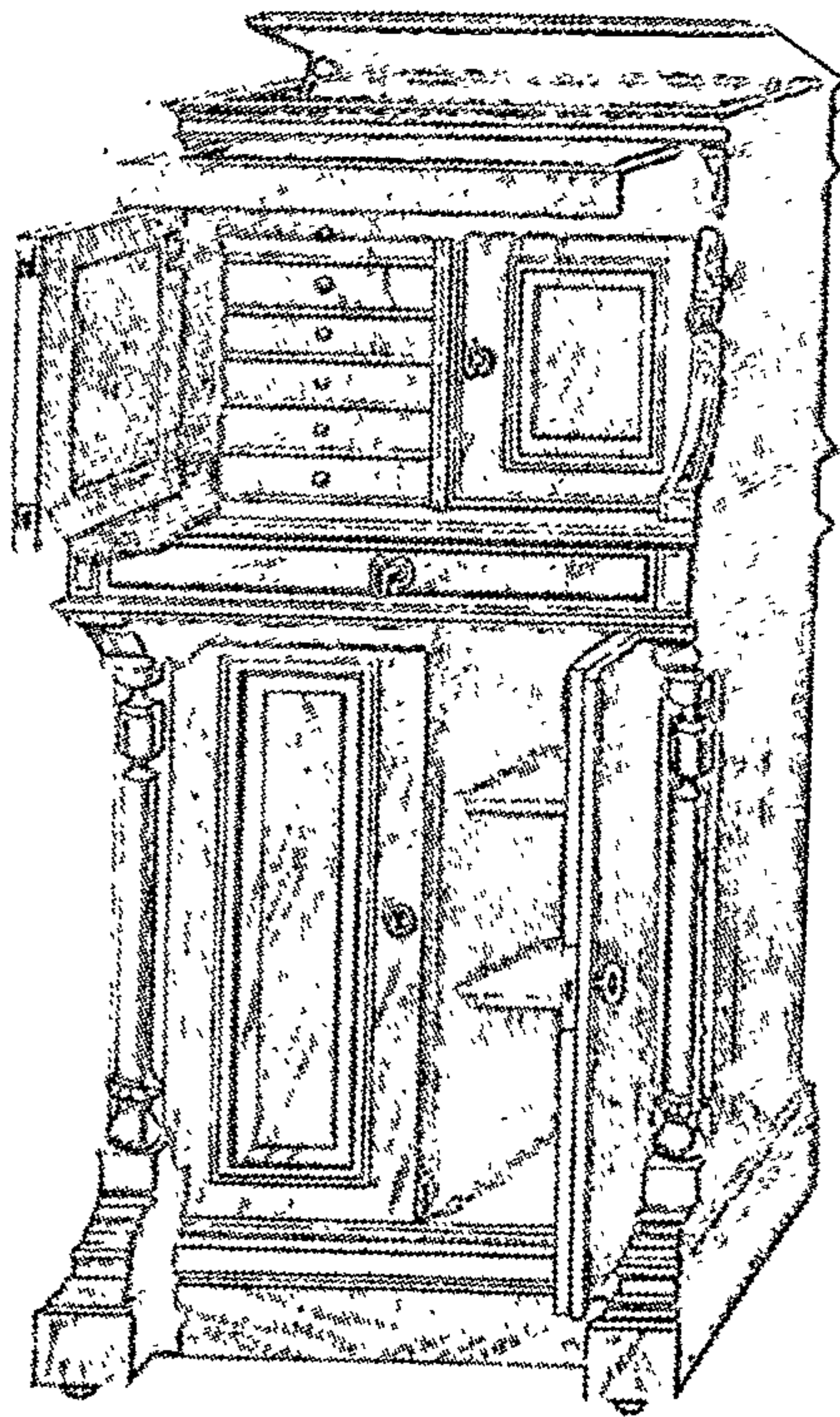


FIG. 3.—Solid walnut dentist's cabinet was 52 inches high, sold in 1867 for \$100.

and stabilized for immediate availability. The operator or chairside assistant should not need to search for, or manually position, this foot control for use in any operating variable position.

12) Floor channels or crawl space underneath the floor should be provided for modern dental equipment installation.

13) Static instruments and immediately needed supplies should be contained in the mobile dental operating cabinet that should be located behind the patient for most effective operation.

14) Operating stools for dentist and assistant should provide for instantaneous variations in height without manual adjustment and should provide body support for cantilevered operating postures, and an elevated foot rest.

15) Only equipment necessary for efficient, organized operating procedures should be placed in the treatment region. This treatment region should not be used for storage of items that are not used regularly.

16) Dental equipment should be designed to function as quietly as possible. Necessary noise should be camouflaged.

17) Unpleasant odors should not be noticeable in the dental office - use efficient evacuative systems.

18) Dental equipment should be designed so that all external and internal parts are readily accessible for installation and service.

19) Dental equipment should be designed to fit in the small operatory, as well as the large.

20) Controls should be provided in dental unit design that enables the dentist to adjust air pressure and volume, water pressure and volume, and oil drip rates to desired standards.

21) Equipment design should provide every needed facility to empty the patient's mouth comfortably and efficiently.

22) Evacuative equipment should be designed with an automatic separating and filtering system that can be disassembled for frequent cleaning and that can function as part of the dental unit.

23) The dental chair back should be as thin as possible.

24) Dental chair base design need not allow for counter-sinking into the floor.

25) Operating lights should be mounted in the ceiling.

26) The dental environment should be well organized, aesthetic, peaceful, and happy.

The dentist at work is characterised by his low energy expenditure and his lack of opportunity for genuine rest pauses, by the restrictions imposed by the task, on the development of "flowing" movements, and his use of large muscle groups to maintain both an unenviable working posture and his working activity.

An inspection of the British Registrar-General's Mortality tables for 1949-53 show that dentists had the highest mortality rate in 45-54 age group and a high rating in 55-64 age group. (57) Table 18

A reduction of these fatigues can be obtained by good equipment design and correct posture in relation to the equipment. Figures 64, 65, 66.

In view of the now considerable number of new designs of dental equipment appearing on the market the dentist must assess this equipment in terms of ergonomics, engineering design, ease of service and maintenance, portability and cost, to suit his particular need. (58)

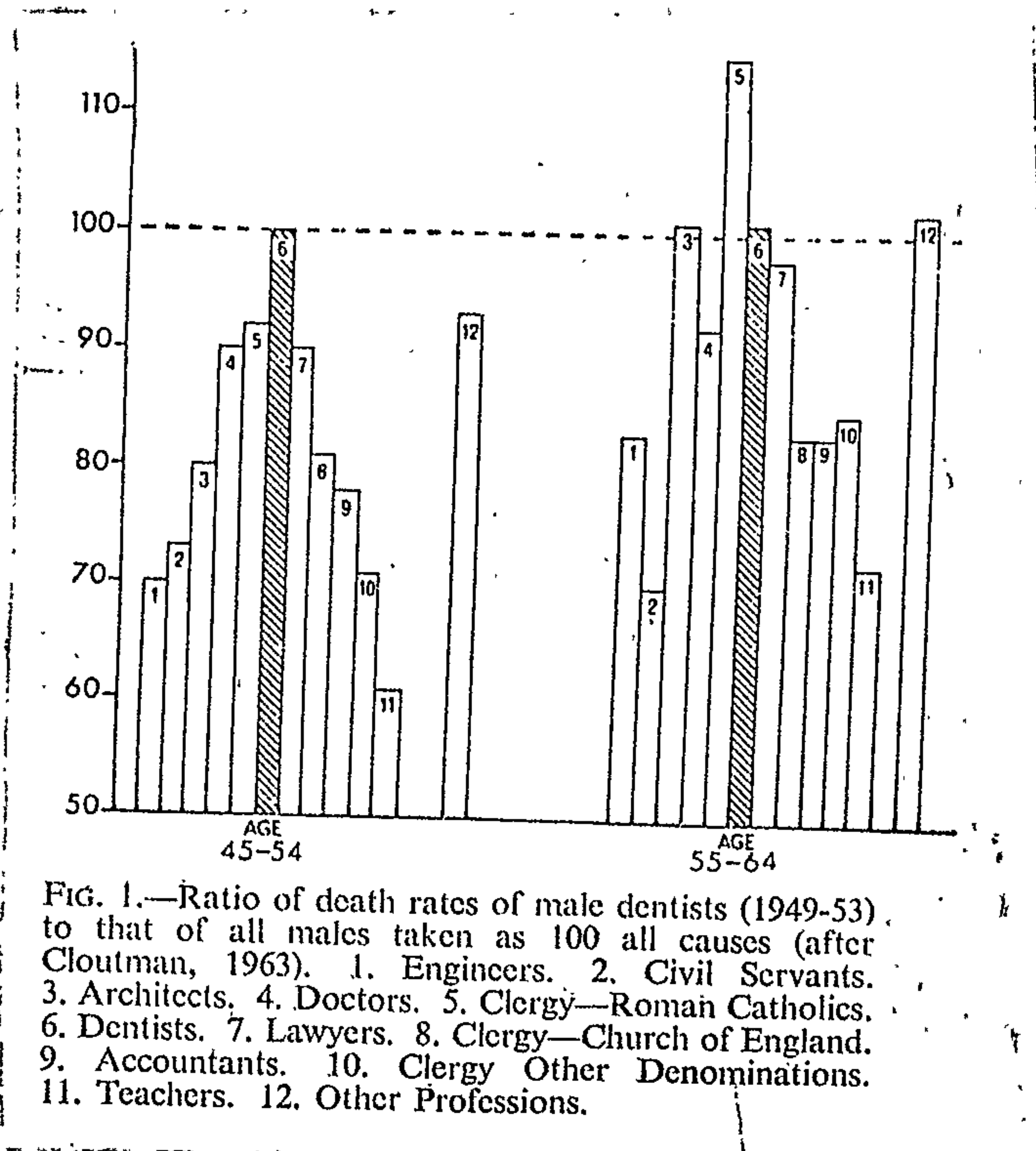


Table 18.

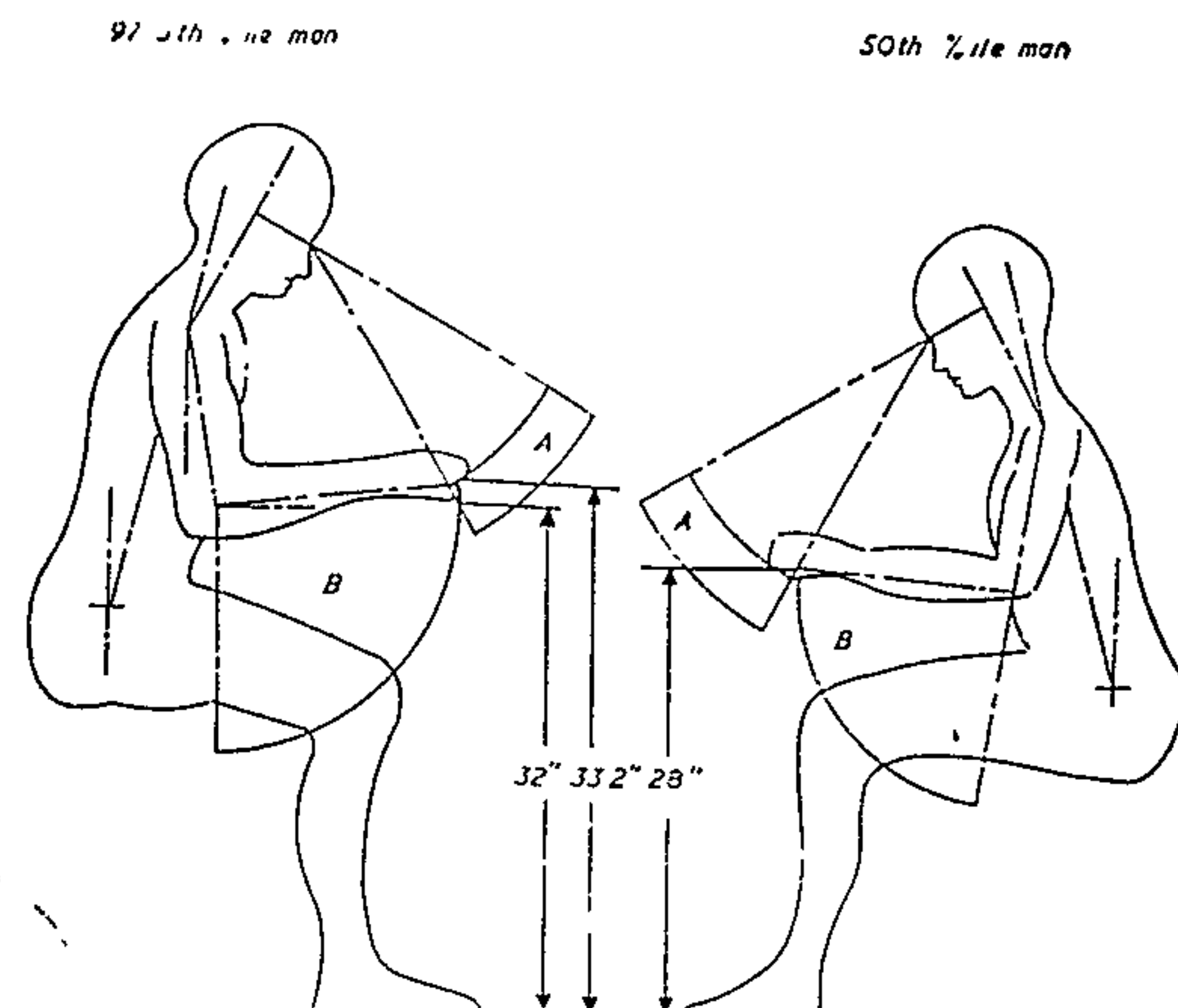


Figure 64.

FIG. 5.—Determining the vertical positions of the patient's head which give the seated dentist good posture and visual/manual access and keep visual and manual fatigue to a minimum.

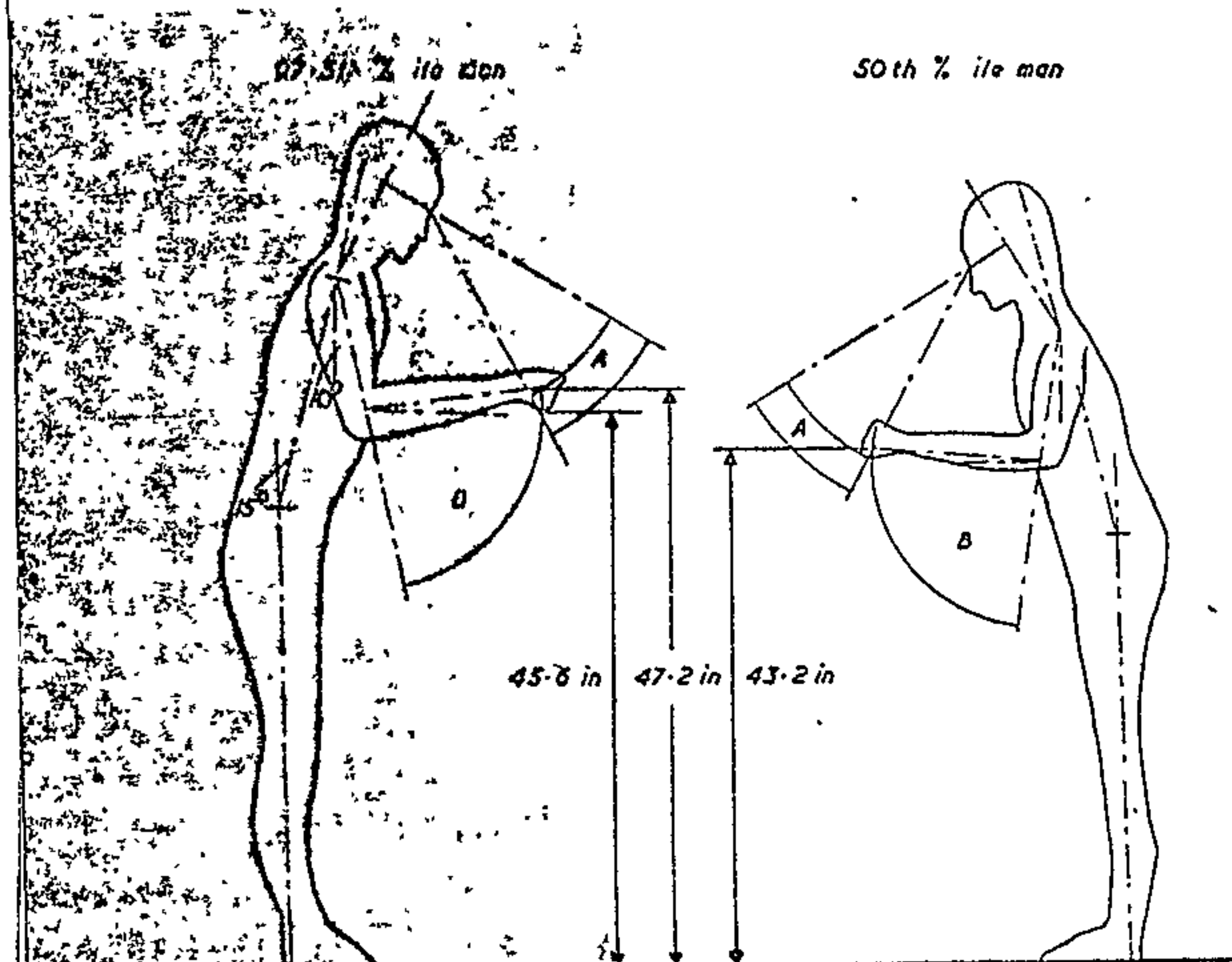


Figure 65.

FIG. 6.—Determining the vertical positions of the patient's head which give the standing dentist good posture and visual/manual access and keep visual and manual fatigue to a minimum.

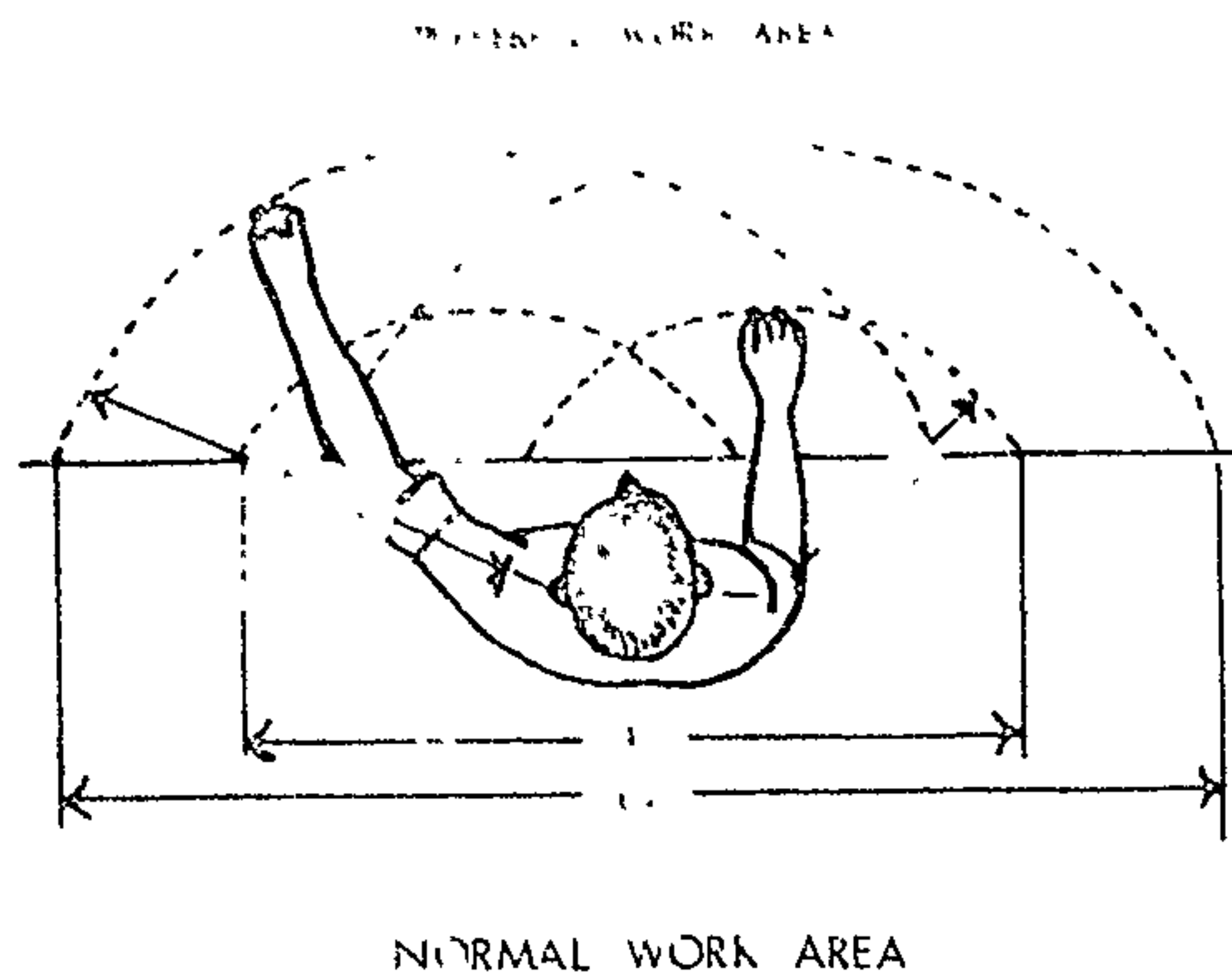


Figure 66.

Dental surgeries are often put together without a logical plan that considers the people who will utilize these facilities. The planning should follow the philosophy that takes into effect all the basic elements laced together to make a "whole". It is conceivable that in the not too distant future new configurations of dental teams may appear that can render the dental surgery design of to-day obsolete. The environmental changes in tools and equipment, must be considered along with the nature of the work team, their style of work, their goals and their willingness to accept and modify. Along with these considerations, people dictate design as they relate to environment, i.e. color, temperature, space, openness, constriction, privacy, movement, tempo, etc. The design of space, after the major consideration of the people and their work, must be functional as it relates to the acceptability of all elements that become included in the confines as defined. Modifications in work procedures may only be possible if there is no constriction of space.

E.T.Hall, the anthropologist, cites experiments that can lead to psychological changes. He interviewed people regarding their reactions to office space. These interviews revealed that the most important criterion is the ability to do work without bumping into something. (59) The element of movement relates to space, like function does to structure. It must consider the functions such as traffic flows of patients and personnel and organized work flow.

Whenever possible design should allow for changes. In the beginning, dentistry started with no more than a dentist, a patient and some tools. Now we have progressed to contour chairs, mobile units, high speed handpieces, oral evacuation, and use of auxiliaries.

10. ORGANISATIONS USING PORTABLE DENTAL EQUIPMENT

1. School Dental services. All Australian States and Territories provide a school dental service using portable and mobile equipment. Some examples will now be given.

Queensland: The State is divided into seventeen dental districts, four of which are serviced by Rail Dental Clinics. In the remaining thirteen districts, Dental Officers use portable equipment and motor vehicles (Station Sedans) are used for transportation. The equipment issued to all officers consists of:-

- Gritter Air Rotor
- Bullows Hydrovane Compressor
(3.25 c.f.m. at 45 p.s.i)
- I.C.I. Aspirator
- Kavo Dental Engine
- "Planet" Dental Light
- "Paramount" Sterilizer
- Portable Dental Chair (Army Type)

Vol.2, Plates 19-22 show this equipment in operation together with packing and transport facilities.

New South Wales: The Division of Dental Services for N.S.W has been involved with the use of portable equipment for fifty years and has reached the stage where a satisfactory dental surgery can be established in any room with a hand-basin and power outlets. Equipment used:-

- Vauxhall Sterilizer
- Gritter Air Rotor (Nash modification)
- Roymax Compressor
- Planet Light
- Kerr Electro-torque
- Christopher-Wayne Foot Control
- Rotobyne Evacuator
- Kavo 710
- Hot-air Sterilizer (Technosteril)
- Eurodent Chair
- Bendix Operating Stool
- Stainless Steel Spittoon (K.G.Luke)
- Tubular Steel chair

CLIENT. DEPT. OF PUBLIC HEALTH.

SIZE. 16'-0" x 8'-0"

NOTE INSULATE ROOF & WALLS

CHASSIS RE-INFORCED
AT THIS POINT FOR
DENTAL CHAIR
APPROX 1,000 LB.P.P. FOR
AIR-COND.NOTE ROLLER
AT REAR.DOUBLE P.P.
OVER BENCH3/4" HT.
5,000
W. HOUSE
AIR-COND.1'-9" x 11"
FIXED
WINDOW1'-9" x 11"
FIXED
WINDOW2/2'-3" x 38"
PICTURE LOUVRE
WINDOWS
4" FROM CEILING.

P.P. UNDER WINDOW.

P.P. ON DOUBLE P.P.
WALL OVER BENCH.2'-3" x 11" L.W.
4" FROM CEILINGP.P. OVER
TABLE

WALL LIGHT.

SWITCH BOARD

NURSES
PREP BENCHHINGED
DOOR

CLOTHS HOOKS

2'-6" x 9" O.H. CUP
2'-6" x 1'-6"
FOLD DOWN
TABLE

6' 3" x 1'-10" TIMBER SEAT

5" FOAM BACKREST

HATCH

HATCH

FAN IN ROOF
OVER
STERILIZER

BASIN

BASIN

5'-5" W/PANS

GAS
WATER
HEATER.

W.P.C.

3'-0" x 22" L.W.
4" FROM CEILINGDOUBLE P.P.
OVER BENCHP.P. OVER
BENCH.P.P. OVER
BENCHP.P. INSIDE
CUPBOARD.2" CAVITY
FOR PLUMBING.

14'-0" x 7'-8 1/4" CHASSIS.

C.C.

2'-6" DOOR & REINFORCED STEP

ANNEXE LIGHT

EXTERNAL P.P.
UNDER VAN.

NOTE. RE-INFORCED CHASSIS AT REAR.

WHEEL PAN CENTRE 2'-0" BEHIND CHASSIS CENTRE

ALSO, EXTRA STEP ON OFFSIDE IN PLACE
POWER INLET.

YORK CARAVANS PTY. LTD.

49-57 PERCIVAL ROAD, SMITHFIELD
N.S.W. 2164

DESCRIPTION

SCALE 1/2" = 1 FT.

DRAWN AW.

CHECKED

PASSED

DATE 23rd. NOV. 71.

DRAWING NUMBER

802.

Figure 67.

The N.S.W. Department of Health has 19 mobile clinics on truck chassis and an Aero-dental service using portable equipment and transported by the Royal Flying Doctor Service, for use in the far west of the state. This equipment is shown set up in Vol.2, Plates 27,28.

Also, Figure 67 shows a detailed plan of the new mobile facilities used by the N.S.W. Department of Public Health. It is similar to the type shown in Vol.2, Plate 24.

South Australia: Excluding dental caravans, the Department of Public Health in South Australia has only one portable dental unit. This is for use as an air-portable unit used to treat aborigines in outback areas of the state. It requires a supply of 240 volt AE current and has a power consumption of 1400 watts. It consists of:-

- An oil-less compressor
- Morita air-bearing handpiece
- Morita three way syringe
- Foot control
- Slow speed micromotor
- High-volume evacuation
- Quartz-iodide operating light
(11,000 lux, image 2½" x 8", focal distance 36")
- Dental Chair is left at the site.

The unit separates into three sections for transportation and weights are 74, 76, and 172 lbs.

Western Australia: Equipment in process of being re-designed for Aero-dental service. Includes a carbon-dioxide driven handpiece and light-weight stand for both light and X-Ray. To be completed in October 1972.

Northern Territory: The Dental Division of the Department of Health in Darwin, have been using CO₂ cylinders as a power source for their portable equipment for approximately six years without serious difficulty. (60) The cylinder being fed via a C.I.G. single-stage regulator to a Gritter "Travelident", which has been modified to use either as Ash or Kavo air-bearing handpiece. The unit operates on almost any

common compressed gas, but CO₂ has been chosen because it can be carried by air, according to D.C.A. regulations. The units have a built-in water tank supplied with distilled water. The bottles were originally pressurised at handpiece pressure (55 p.s.i.) but a problem developed with leaky water valves and this was eliminated by regulating the pressure down to 18-20 p.s.i.

Small fluoridation plants are in use:

1) A constant flow type:- used where the flow is known not to vary and is actuated by a flow switch in the water main, so that delivery starts automatically as soon as the supply pump is switched on.

11) Variable flow type:- uses a water meter to measure flow through to main and to deliver fluoride in an appropriate quantity. Mixing being accomplished by the turbulence in the main.

11) Hospital Dental Services

Apart from the static dental clinics used in hospitals, there is a requirement for mobile and portable dental equipment, for use in the operating theatre and in the wards. Small portable dental engines, bracket mounted, are used in Oral Surgery, also mobile carts, CO₂ powered as shown in Vol.2, Plate 36 are also used for operative dentistry. Equipment of the "suitcase" type, like the Encore or Beldent are used for treatment of bed patients. Plate 60 shows a mobile modular cart made by R. Guntz (Kavo) for use in Hornsby District Hospital, Sydney. It incorporates:

- Planet light
- Air compressor
- Cabinet storage space
- Electr-torque motor
- Foot control

Plate 13 shows a bed patient receiving treatment

Plate 31 shows the Beldent "surgery in a suitcase".

Plate 12 shows older type with belt-driven handpiece.

iii) Dental Public Health Agencies

An example of this, is the Dental Health Service of the Territory of Papua and New Guinea, which currently maintains 45 fixed clinics and three mobile clinics.

In addition, the current field service establishment is 16 dental officers, 58 dental therapists (operating dental auxiliaries), 15 dental technicians and 61 dental orderlies (chair-side assistants).

The portable equipment consists of:-

- Kavo 706A electric units
- Denta-Werk electric units
- Kavo combined foot engine and electric foot engines
- Honda, E-300, 240V generator to supply power to unit
- Portable wooden instrument kit
- Portable tubular steel chair
- Planet lights
- Electric sterilizer, where power is available, or primus heated kettle
- Instrument cabinet

All equipment, excepting the instrument cabinet, folds up and can be packed into two or three, 2-man patrol boxes. This equipment is shown in Vol.2, Plates 61,62.

Portable equipment is also used to train dental students and dental auxiliaries; Vol.2, Plate 63 show a foot-engine in use by student school dental nurses at the Penang Dental Training School, Penang, Malaysia.

State health departments also use mobile and portable equipment to service institutions and child welfare homes, under their control.

The United Dental Hospital of Sydney has two Rail-cars and one semi-trailer fitted out with standard dental equipment and used as mobile clinics, in areas of the state not well served with dental facilities.

iv) Armed Services.

Because of the large number of personnel involved and because of service requirements to maintain these personnel in a dentally fit state, the Armed Services generally supply comprehensive portable and mobile facilities. The three Australian Armed Forces indent on the Army for dental supplies and equipment through their Army Base Medical and Dental Stores. An example of the way dental stores and equipment are catalogued is shown in Table 18.

Vol.2, Plate 64 show the lay-out of the field equipment available to the dental services of the three Australian Armed Services. Because of differing service requirements, differing portable equipment is used, dependent on circumstances.

Army: Generally uses the field set-up. This is shown in Vol.2, Plates 65,66 in operational use in Vietnam. Plate 65 shows the full Army field kit set up in a tent with concrete block floor.

Plate 66 shows a unit, with standard dental chair, more sophisticated basic equipment, in a prefabricated aluminium hut.

Navy: Plates 43,44 show the newly modified Kavo 652 to be used in R.A.N. ships. Plate 44 shows the water reservoir for the triplex syringe. Plate 43 shows the junction box and electro-motor. Plates 7,8, show the dual use to conserve space in a R.N. ship. The operating theatre is converted into a dental surgery. In small ships portable equipment is used. This situation is shown in Plates 15,16.

Air Force: The requirements of the R.A.A.F. are different again, relying on a modular or containerized dental clinic that can be air-lifted by heavy transport aircraft in

service with the R.A.A.F the C-130 "Hercules". Vol.2, Plates 69-74 show this facility.

Canadian Armed Services: This organization has the one dental service and as of recently, an integrated armed service. They use dental vans on a 6 x 6 chassis, Encore portable units and Beldent portable units. They are in the process of purchasing the field set-ups manufactured by Dental-Ez/A-Dec which are shown in Plates 35,75,76.

United States: Because of the large number of personnel in the United States services, their equipment is more comprehensive. The U.S. Army has developed "Medical Unit Self-Transportable" (MUST) mobile hospitals, which have a dental component. These units are shown in Plates 75,76. Plate 75 shows the field set-up in an inflatable tent. Plate 76 shows the set-up in an aluminium transportable module. In the U.S. Navy as well as providing mobile clinics at sea, by placing a module clinic as shown in Vol.2, Plate 25 on the deck of the ship, they also provide treatment for Marines and Sea-bees. Plate 17 shows a dental clinic being moved into a forward position in Vietnam. Plate 18 shows this clinic set up, note small portable generator in right foreground.

An appendix of portable equipment available to the U.S. Department of Defence has been included in their Federal supply catalog. (Figure 68)

British Services: British Armed Forces are supplied with dental caravans as shown in Vol.2, Plates 23,24. These are of the standard pattern.

CES (Ausl) No 614
ISSUE 1
DATED JAN 1966

EQUIPMENT TABLE - PART 4
COMPLETE EQUIPMENT SCHEDULE
DENT FOR

DENTAL EQUIPMENT SET, OPERATING, FIELD, ARMY PATTERN

IMPORTANT

The stock number and designation which identifies the total collection of items listed in this CES is:—
6545-66-019-9784 DENTAL EQUIPMENT SET, OPERATING, FIELD, ARMY PATTERN
(CES 6141)

CONTENTS					
PART 1 — BASIC ITEM					
PART 2 — NOT APPLICABLE					
PART 3 — INFORMATION SECTION					
		AMENDMENTS			
		BULLETIN No		DATE	

Table 19.



FEDERAL SUPPLY CATALOG

**C
O
N
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D**

IDENTIFICATION LIST

FSC 6520

**DENTAL INSTRUMENTS,
EQUIPMENT, and SUPPLIES**

IMPORTANT NOTICE

SUPERSEDES C-6520-1L, DATED 1 OCTOBER 1969

1 JANUARY 1972

Figure 68.

SINGLE-ENDED

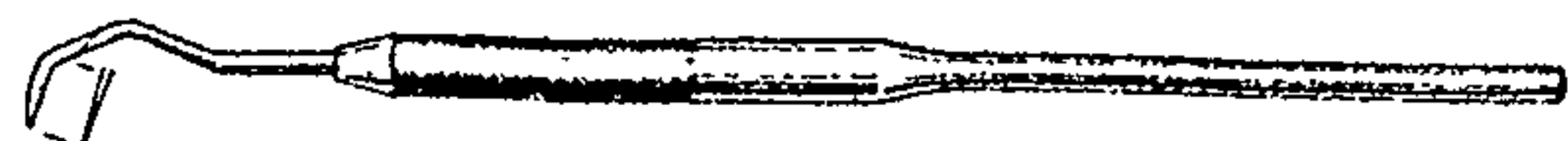
Index No. 1430—For complement, order Index No. 1435.

Index No. 1435—For complement, order Index No. 1430.

Action	Index No.	Federal Stock No.	Descriptive Data
AMALGAM. One operative end of a double-ended Tanner 6T carver.			
—	1430	6520-498-2810	Tanner, No. 6TA
—	1435	6520-498-2811	Tanner, No. 6TB
AMALGAM AND WAX			
—	1445	6520-511-3000	Frahm, No. 1
—	1450	6520-511-4000	Frahm, No. 2
—	1455	6520-511-5000	Frahm, No. 3



Index No. 1430



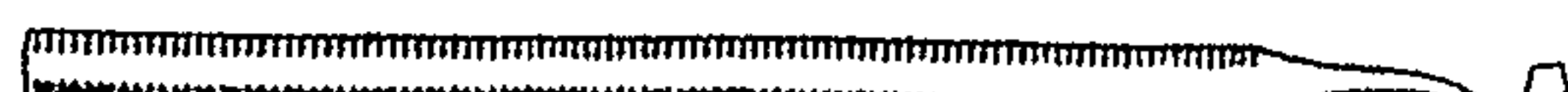
Index No. 1435



Index No. 1445

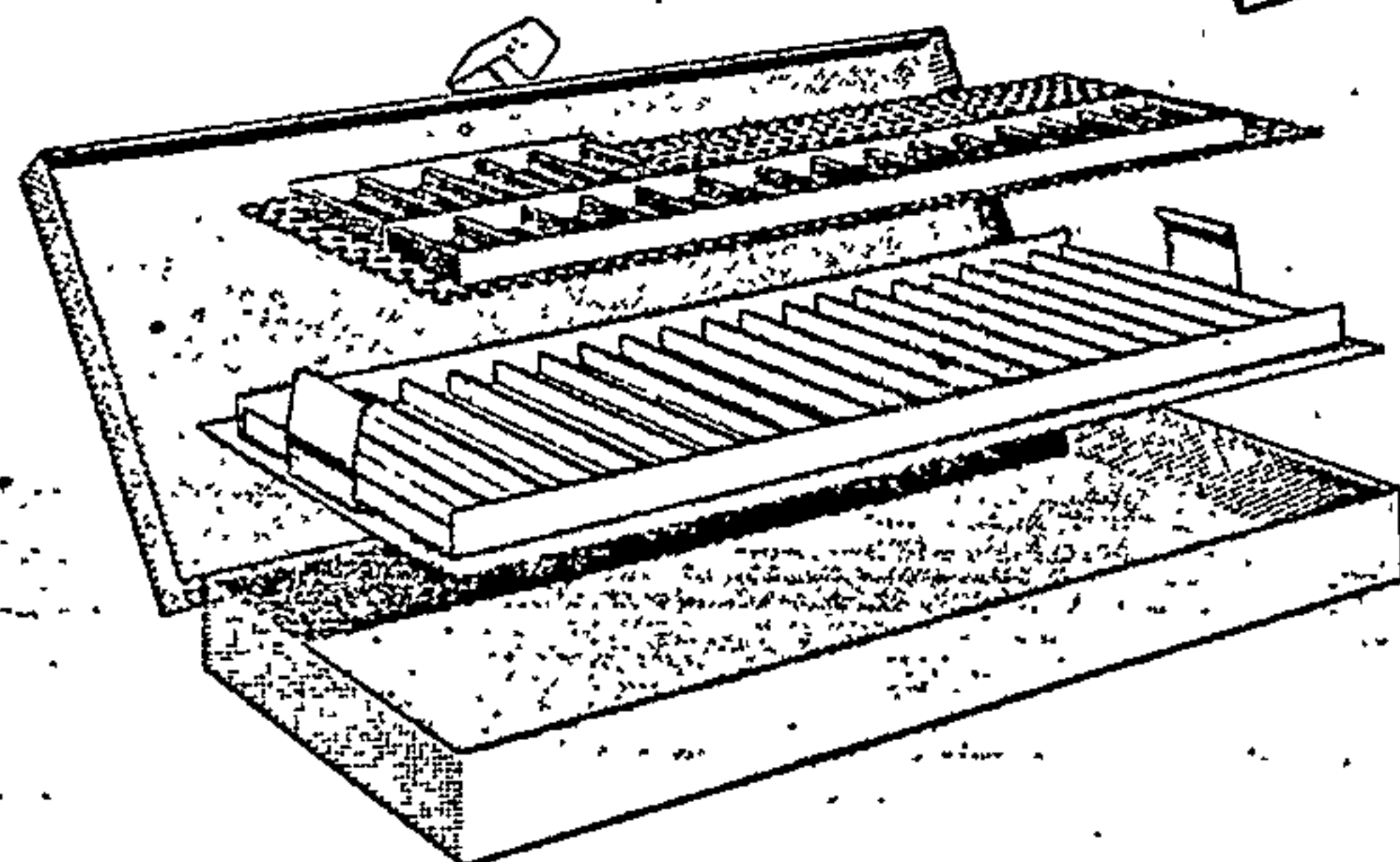
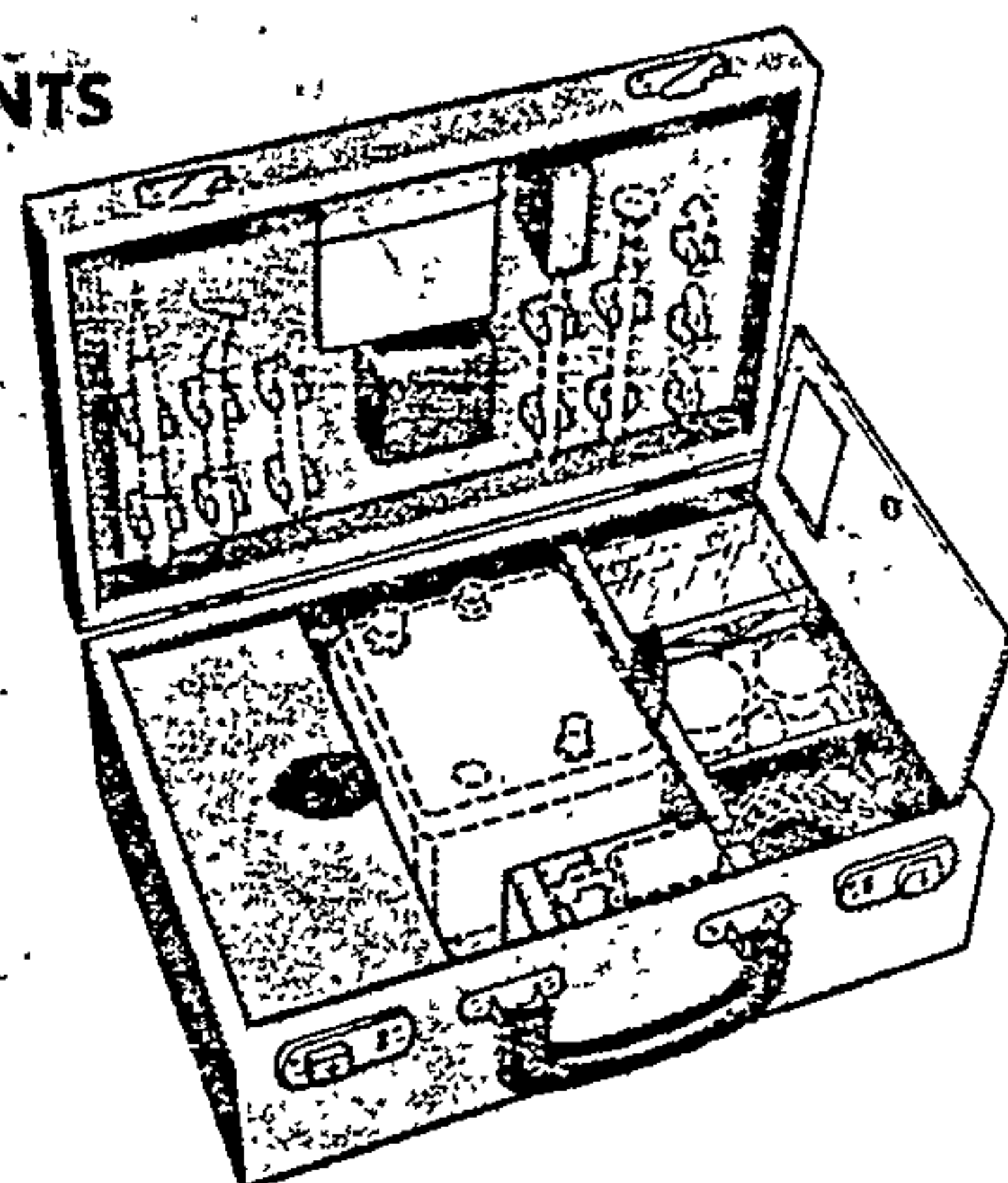


Index No. 1450



Index No. 1455

CASE, DENTAL INSTRUMENTS

Index No.
1465Index
No.
1470

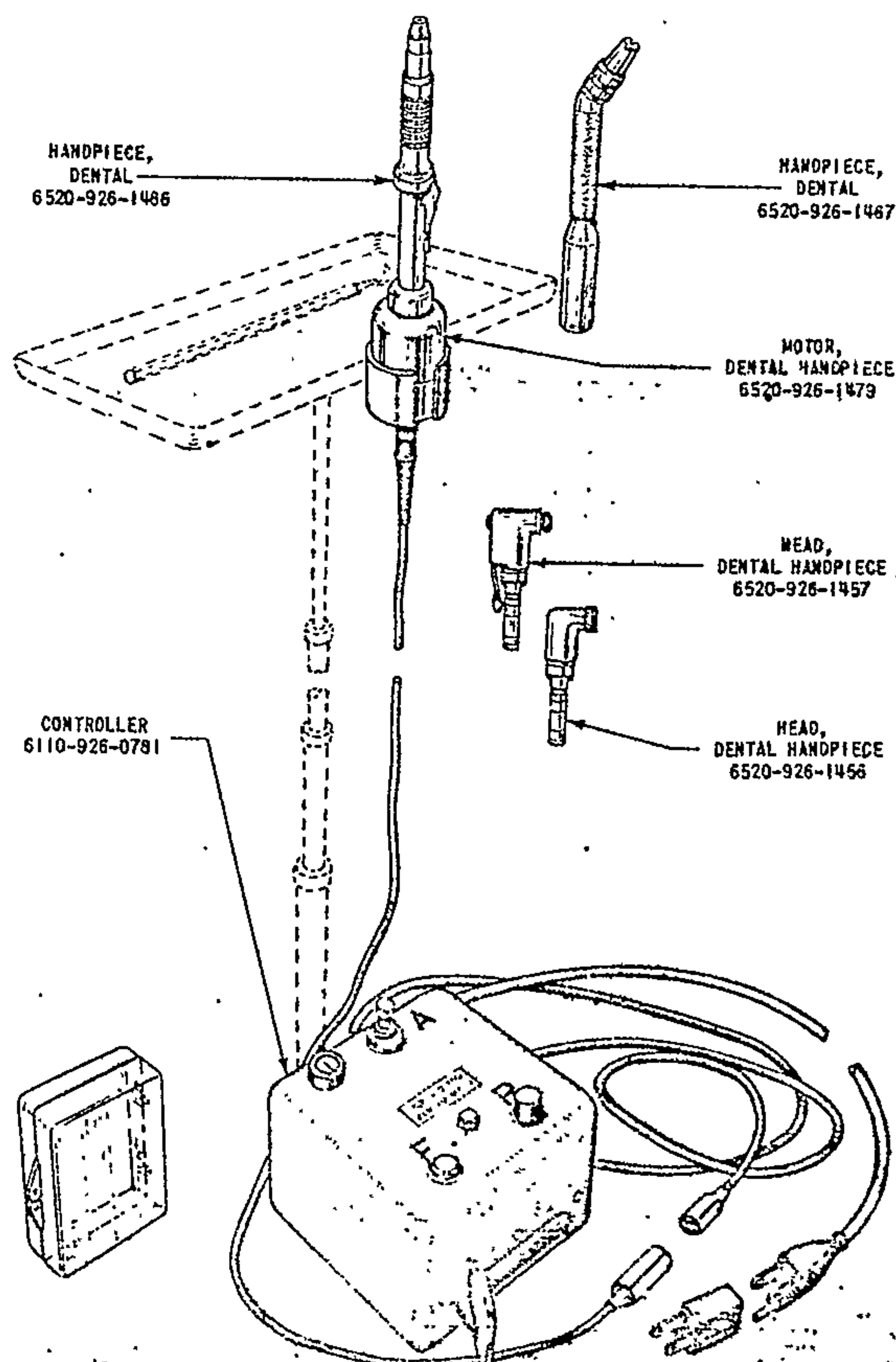
Index No. 1465—14-1/8 in. long, 9-1/2 in. wide, 5-1/4 in. high. With hinged cover and two locking latches. Compartmented for storage of handpiece motor, Index No. 5385; controller, 6110-926-0781; handpiece head, Index No. 4420 and 4425; straight handpiece, Index No. 4370; and contra-angle handpiece, Index No. 4350. With plastic container for small accessories.

Index No. 1470—11 in. long, 5 in. wide, 1-1/8 in. high. With cover, two removable compartmented trays, and mixing slab. Container for long- and short-handled endodontic instruments.

Action	Index No.	Federal Stock No.	Descriptive Data
—	1465	6520-926-1461	Carrying
—	1470	6520-890-1883	Sterilizing and Storage, Corrosion-Resisting Metal

HANDPIECE, DENTAL, MOTORIZED
(View of assembled components)

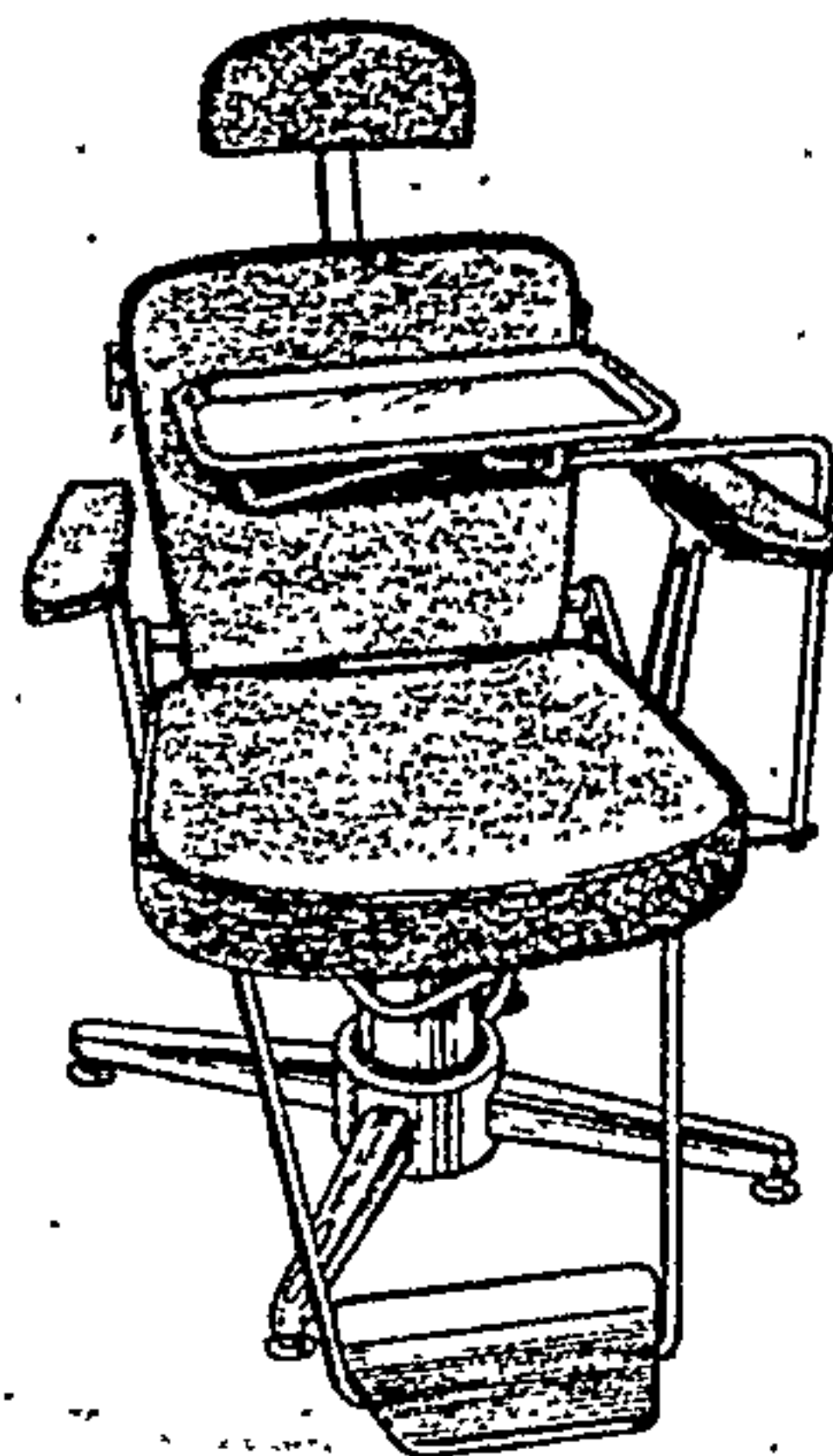
Components are to be ordered for use in CASE, DENTAL INSTRUMENTS, FSN 6520-926-1461.



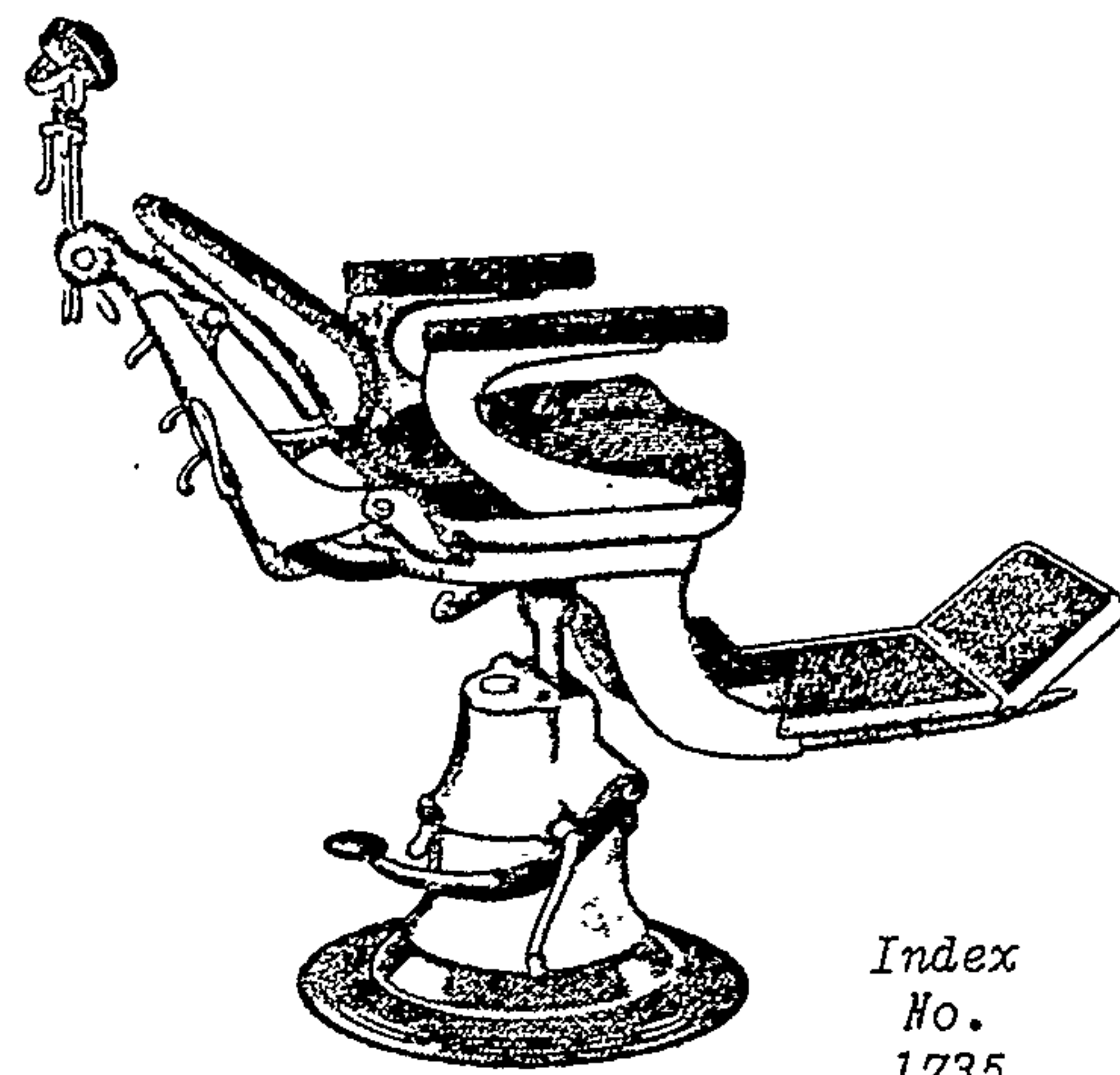
CEMENT, ZINC PHOSPHATE, DENTAL

Consists of bottle of liquid and bottle of powder. For crownwork and bridgework.

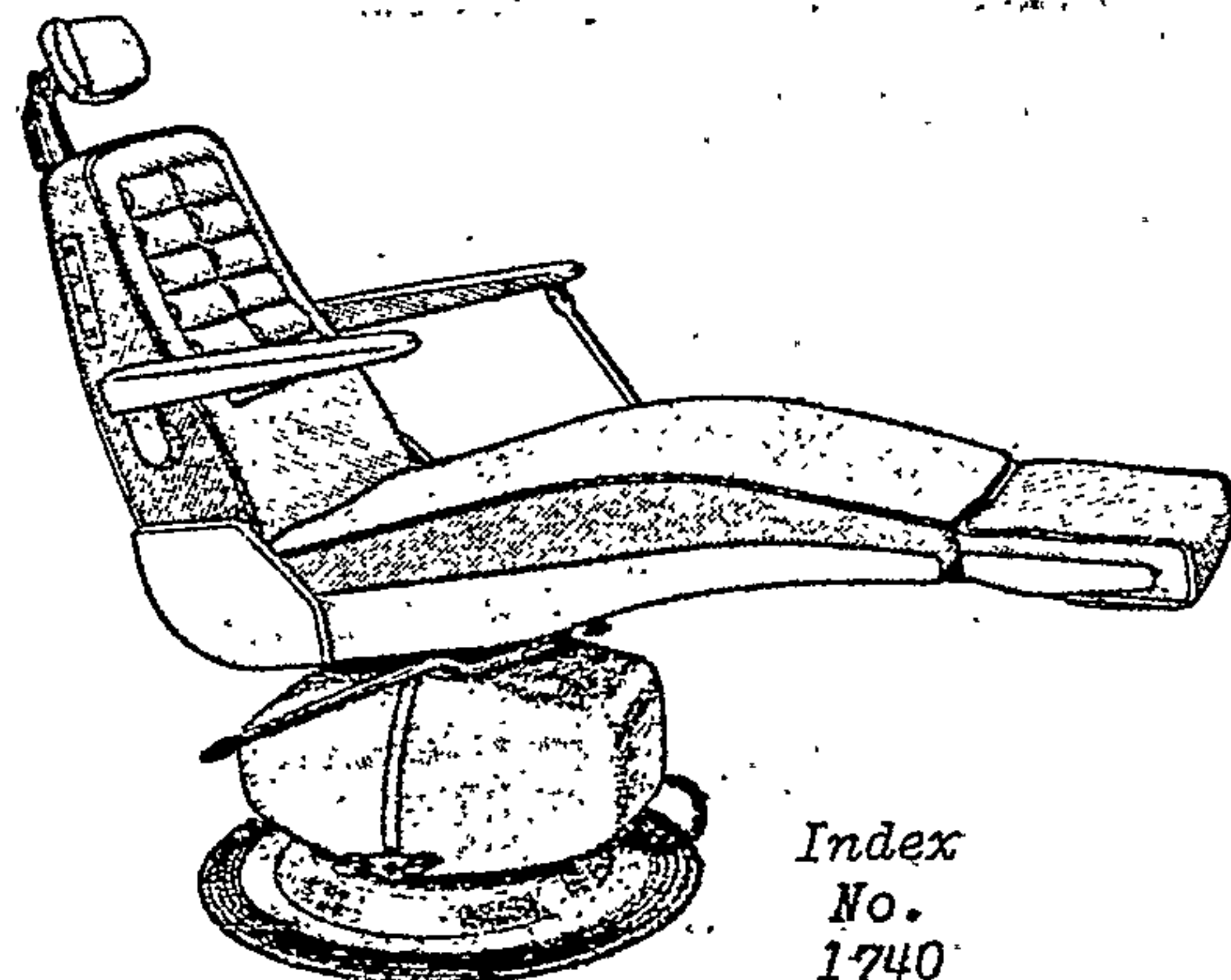
Action	Index No.	Federal Stock No.	Descriptive Data	Notes
—	1715	6520-514-2350	Light Gray, 1 oz	D
—	1720	6520-514-2450	Light Yellow, 1 oz	D

CHAIR, DENTAL OPERATING

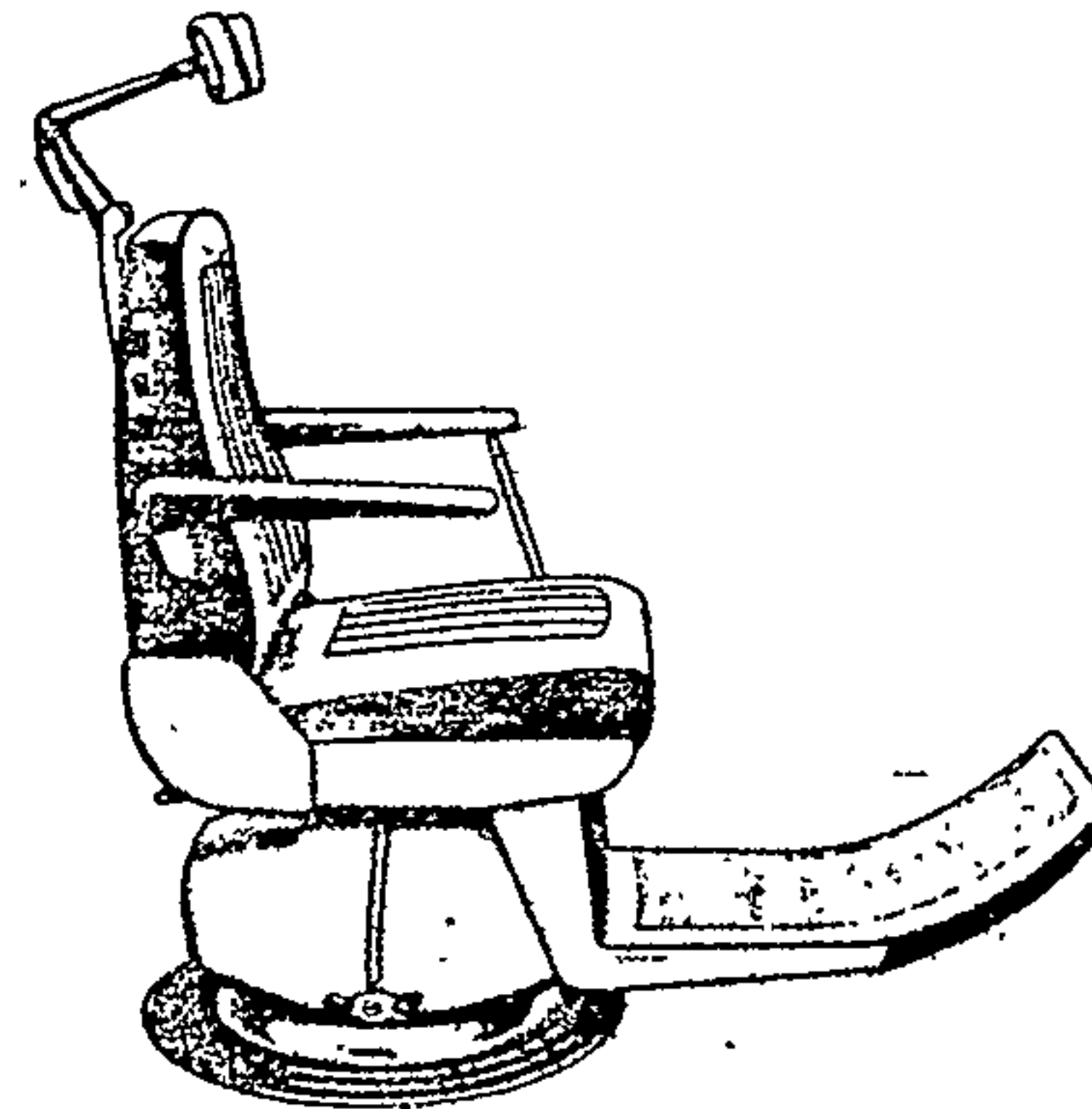
Index
No.
1730



Index
No.
1735



Index
No.
1740



Index
No.
1745

Index No. 1730—Blue, gray, green, tan, or white. Foot-operated hydraulic pump system to elevate and lower the chair; adjustable backrest and headrest; platform type footrest, armrests, and tray support. Plastic upholstered. The choice of color should be included in the requisition. For tray, order 6530-926-9170.

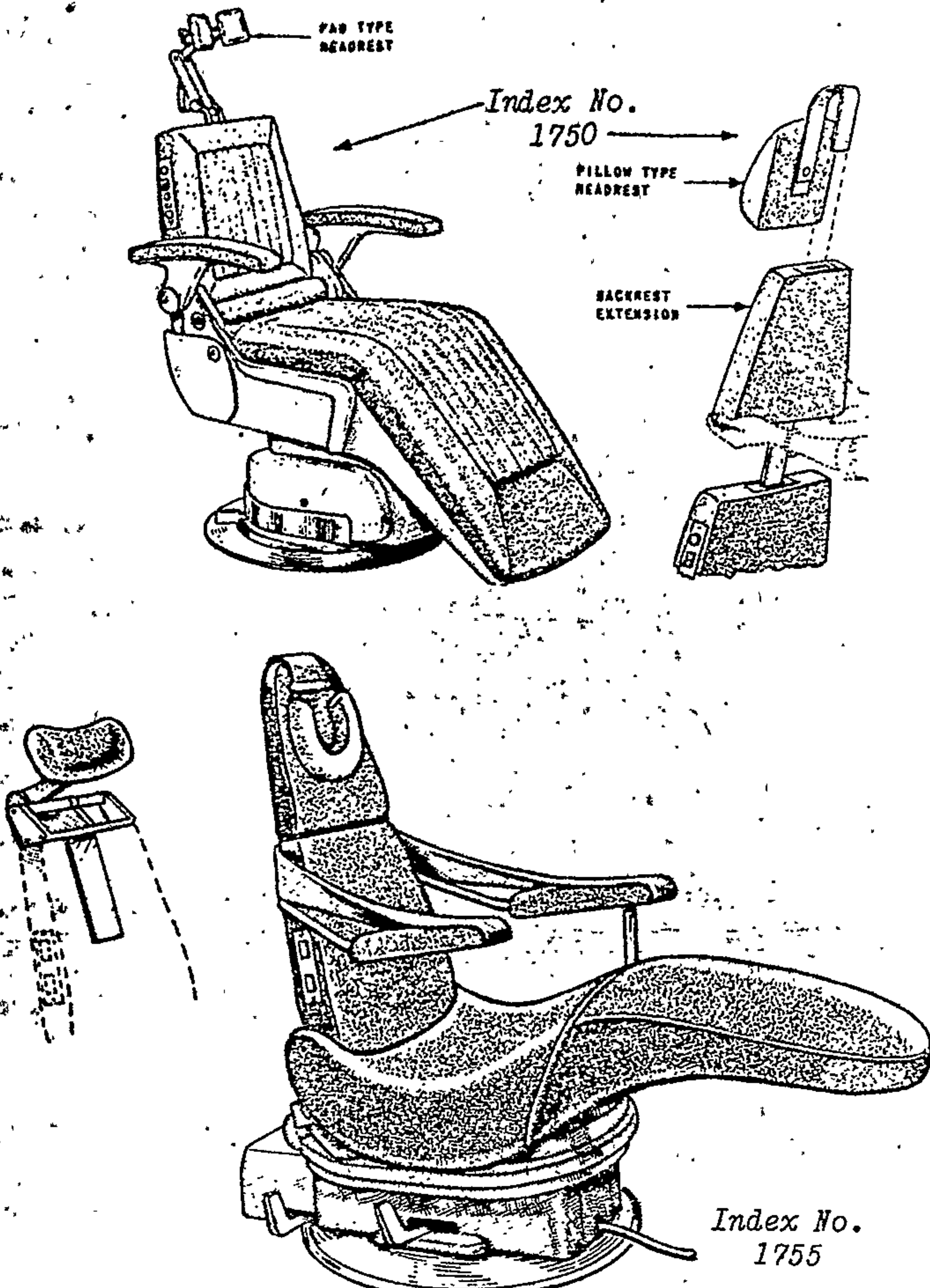
Index No. 1735—Not available for general peacetime requirements. White. Hydraulic-pump type; adjustable back, arm supports, footrest, and headrest with self-adjusting pads. Leather upholstered seat and back. For semicircular floor mat, order 7220-541-1000. Use SAE No. 30 oil for hydraulic pump.

Index No. 1740—560 watts. Blue, coral, green, tan, or white. Lounge type; with a conventional, adjustable, locking, pad-type headrest or an articulating lounge headrest; with removable footrest. Foot-operated control for rotation; hydraulic pump system to elevate and lower the chair, and to control the forward and backward movement of the backrest. Plastic upholstered. The choice of color and type of headrest should be included in the requisition.

Index No. 1745—560 watts. Blue, coral, green, tan, or white. Conventional type; with footrest. Foot-operated control for tilt and rotation; hydraulic pump system to elevate and lower the chair, and to control the forward and backward movement of the backrest. Plastic upholstered. The choice of color should be included in the requisition.

Action	Index No.	Federal Stock No.	Descriptive Data
—	1730	6520-455-9952	Auxiliary, Lightweight
—	1735	6520-514-3800	Foot Operated
—	1740	6520-904-1885	Motor Driven, Round Base, 110 volt, 60 cycle, AC
—	1745	6520-905-1072	Motor Driven, Round Base, 110 volt, 60 cycle, AC

CHAIR, DENTAL OPERATING (Cont'd)

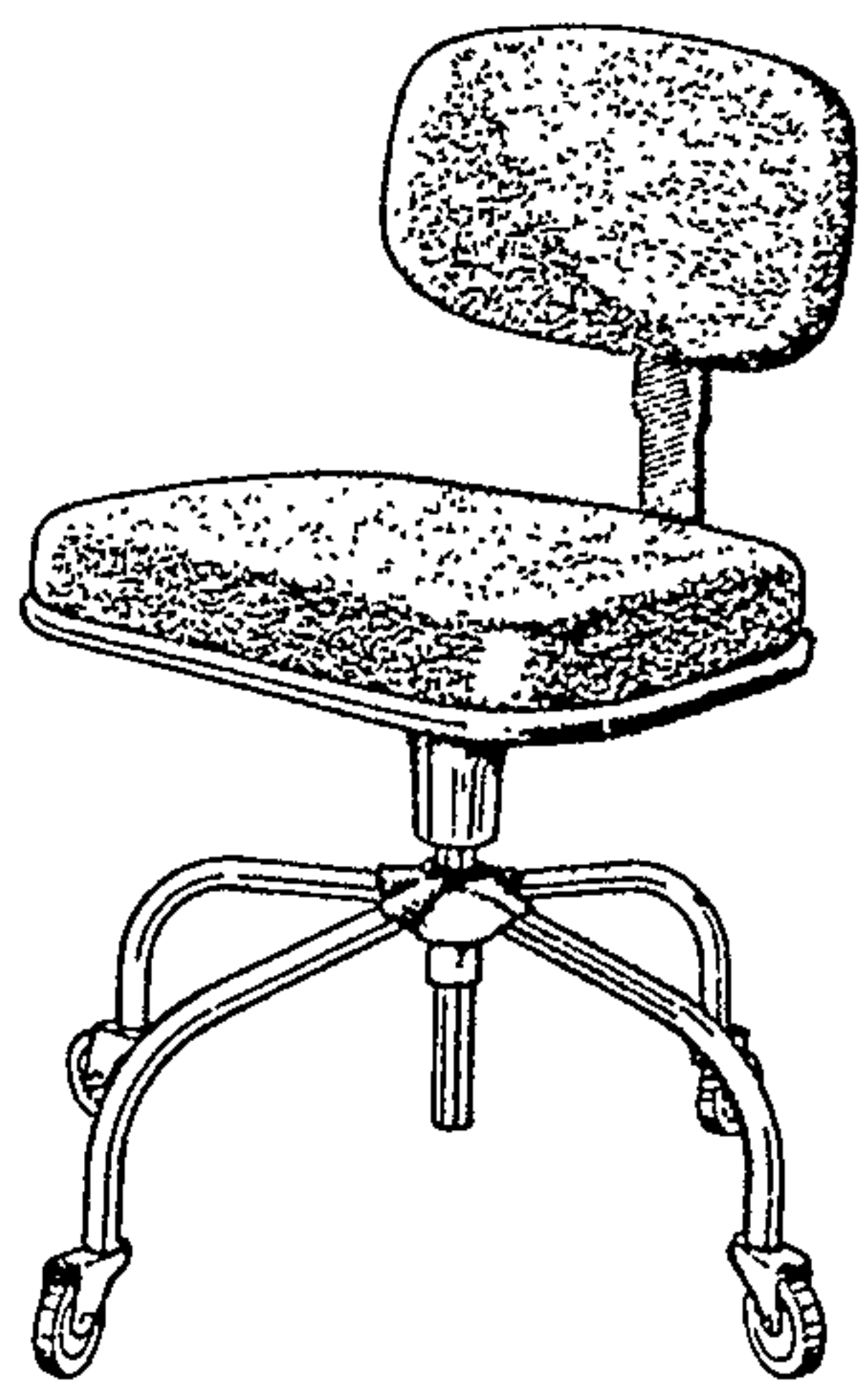


Index No. 1750—Not suitable for installation aboard Naval vessels. 595 watts. Blue, coral, green, heather, or white. Lounge type. Two-piece back construction. With lower backrest and extension if ordered with rotatable, counterbalanced, pillow-type headrest. With lower backrest only if conventional adjustable, locking, pad-type headrest is ordered. Foot-operated or button-operated control for raising and lowering by hydraulic pump system. Foot-operated control for rotation. Button-operated control for reclining and tilt-up positioning of backrest. Leather upholstered. The choice of color and backrest-headrest combination should be included in the requisition.

Index No. 1755—600 watts. Blue, gray, green, off-white, or tan. Lounge type; with two headrests: a "U" shaped cushion type headrest for use on low and high back; a prosthetic (conventional) type headrest for use on low back. Foot-operated control for rotation. Jackscrew systems with controls on each side of lower backrest for elevating, tilting seat, and forward and backward movement of the backrest. Plastic upholstered. The choice of color should be included in the requisition.

Ac-tion	Index No.	Federal Stock No.	Descriptive Data
—	1750	6520-905-7896	Motor Driven, Round Base, Knee-Flex Action, 110 volt, 60 cycle, AC
—	1755	6520-110-5545	Motor Driven, Round Base, Precision Lift, 110 volt, 60 cycle, AC

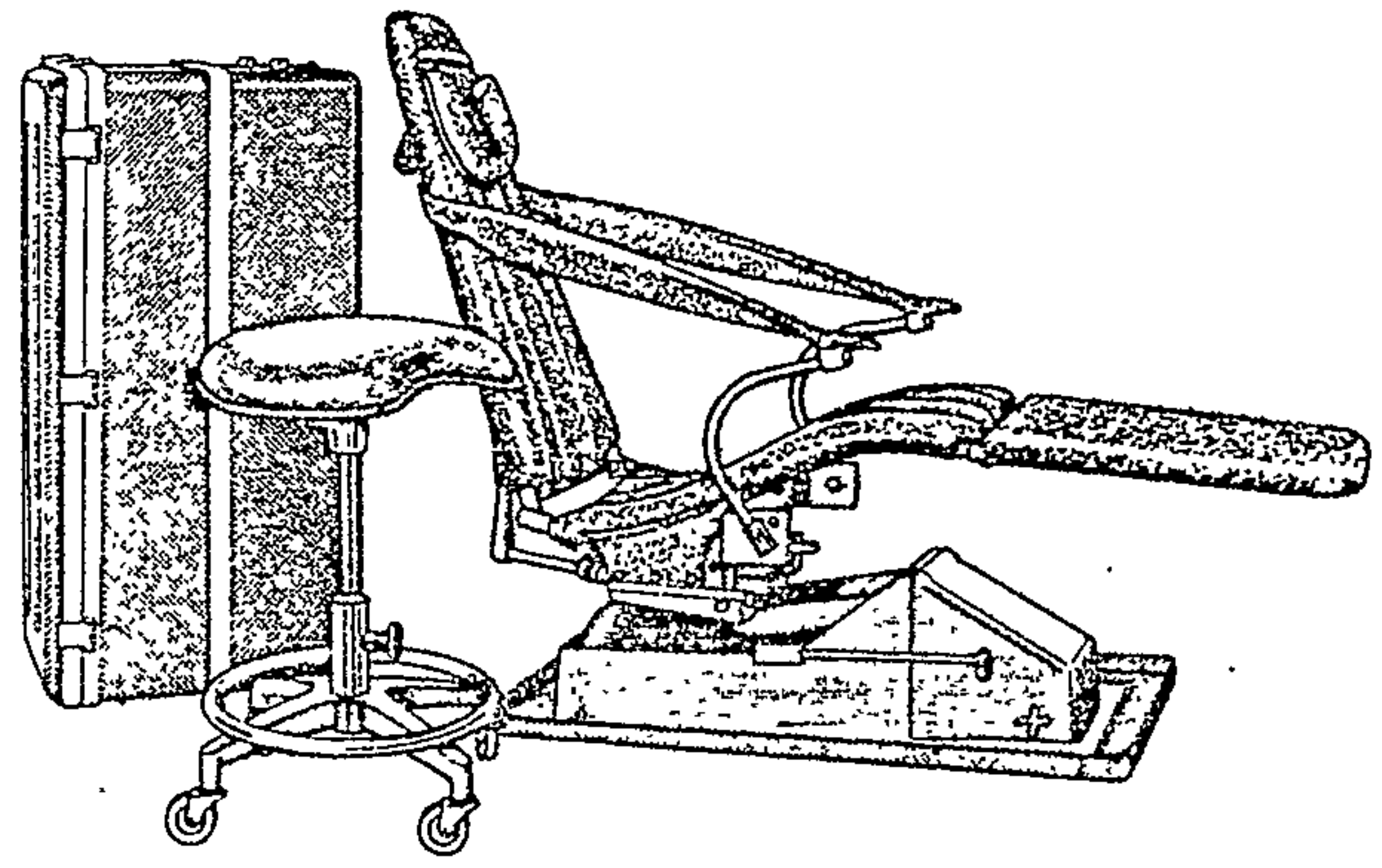
CHAIR, ROTARY



Posture and swivel type; adjustable; mounted on casters. With nontilting padded seat and back; removable plastic covers.

Ac-tion	Index No.	Federal Stock No.	Descriptive Data
—	1765	6520-514-5050	Dental Prosthetic Laboratory

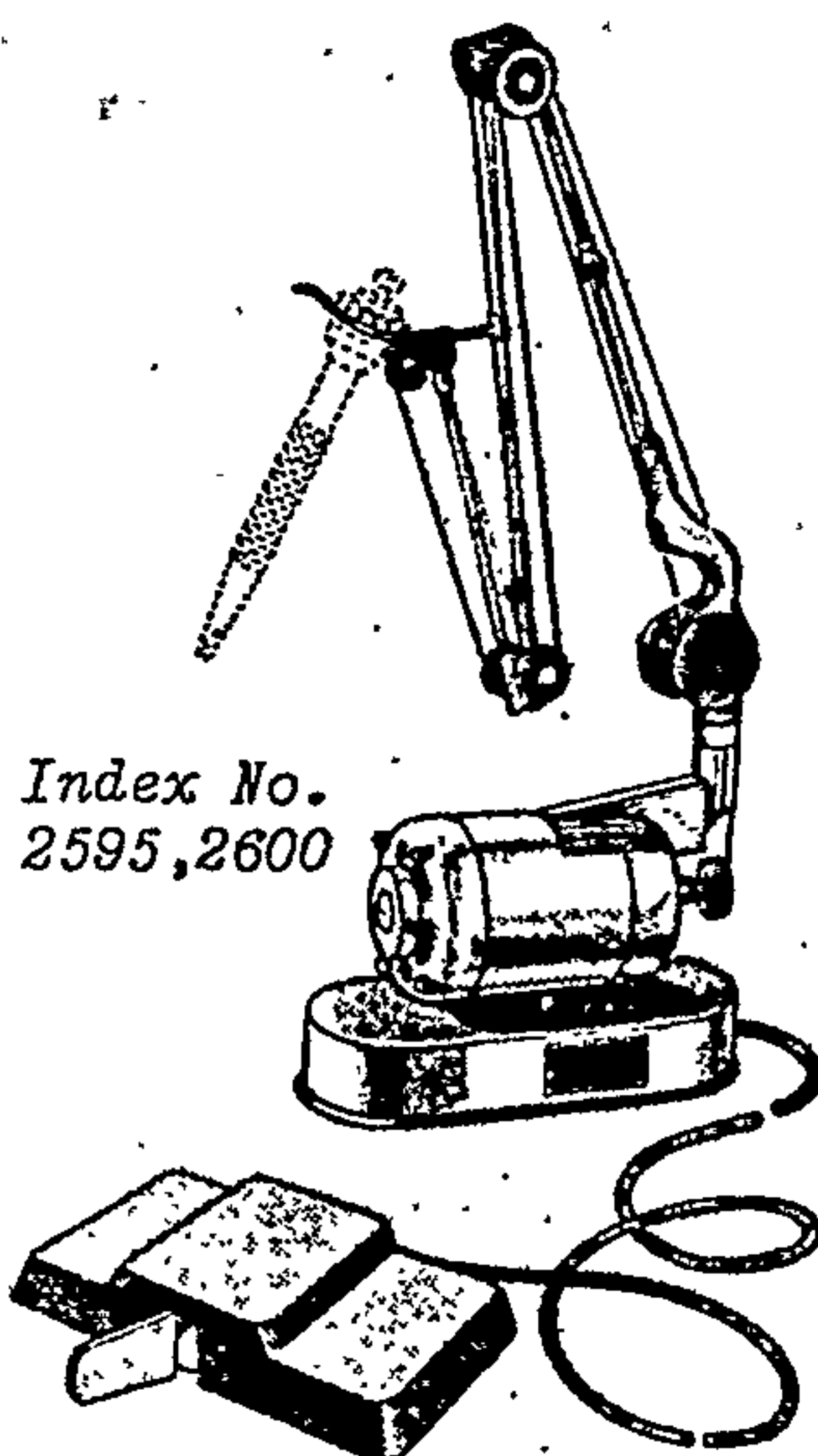
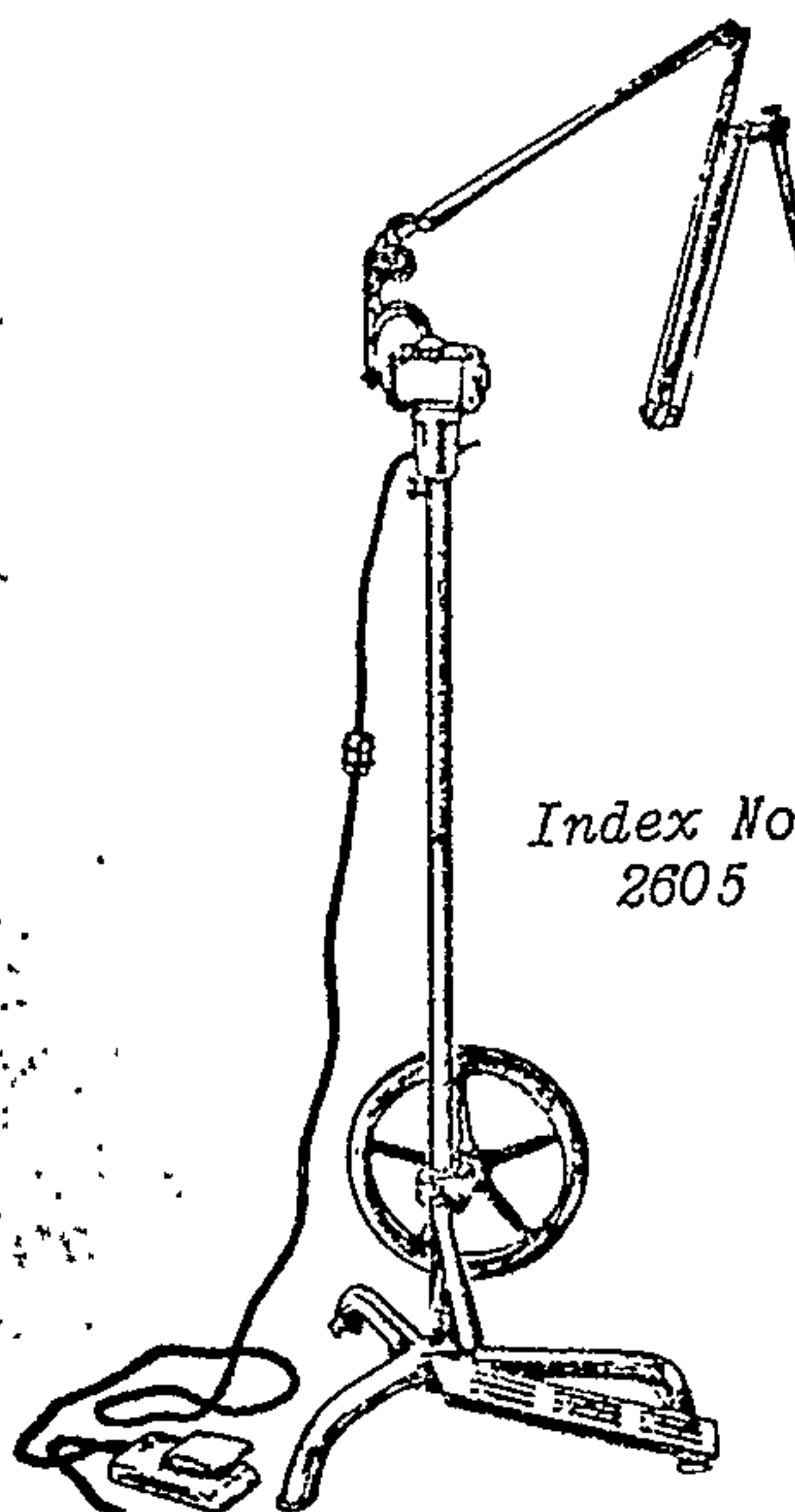
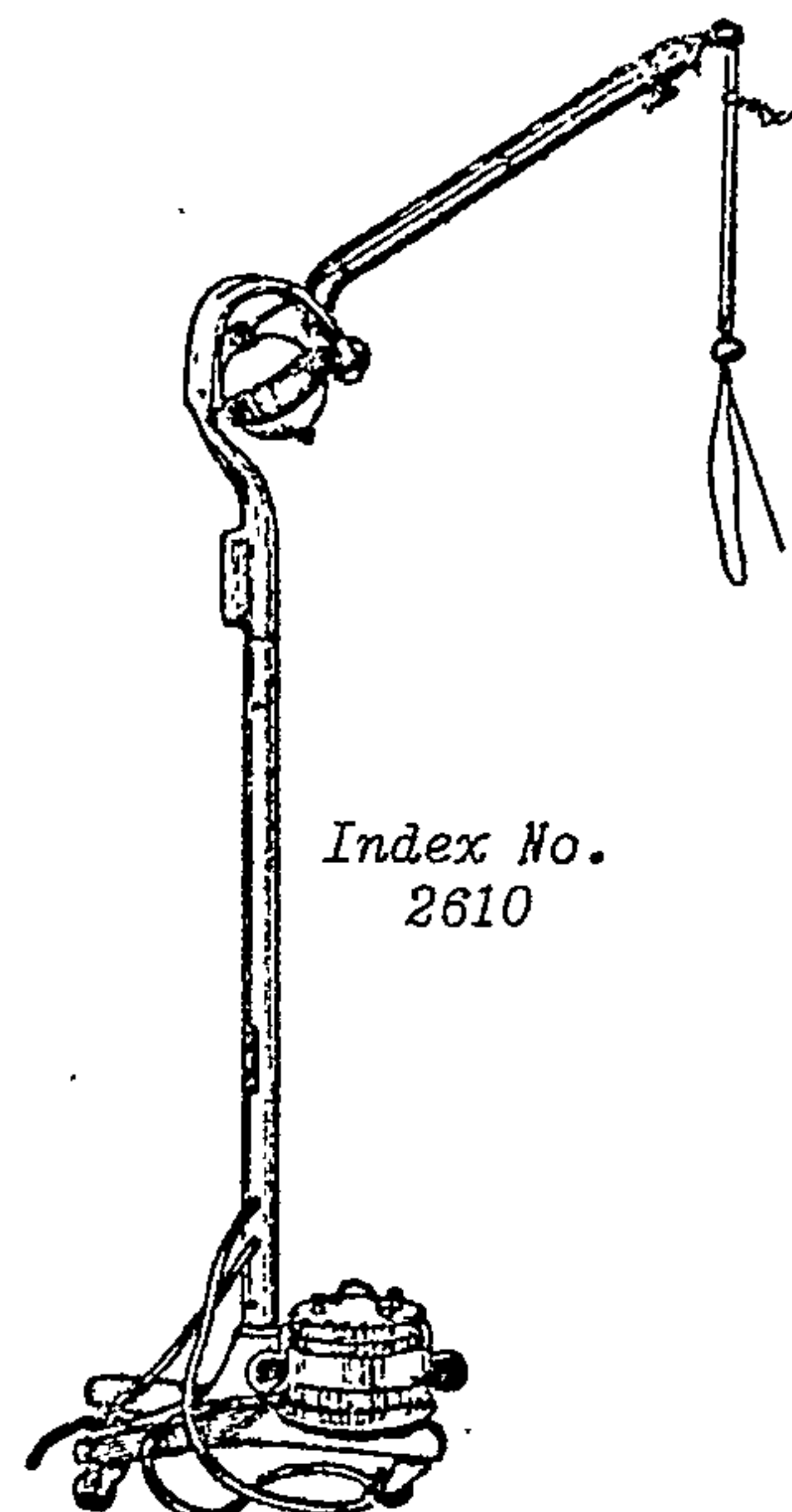
CHAIR AND STOOL UNIT, DENTAL OPERATING



Field type. In carrying case.

Ac-tion	Index No.	Federal Stock No.	Descriptive Data
—	1775	6520-181-7349	Portable

FOR STOOL, DENTAL OPERATING CHAIR, SEE INDEX NO. 6995-7005.

DENTAL ENGINEIndex No.
2595, 2600Index No.
2605Index No.
2610

Belt arm and cable assembly. With foot-operated rheostat, except Index No. 2605, foot-operated controller. For straight handpiece, order Index No. 4355 or 4360, except Index No. 2600, order Index No. 4365.

Index No. 2595—For replacement belt, order 3030-542-1550 for Weber unit, or 3030-926-3816 for Emesco unit.

Index No. 2600—34,000 rpm speed range. With short, 3-section belt arm and cable assembly, and two 6 ft 6 in. engine belts. For replacement belt, order 3030-926-3816.

Index No. 2605—Foot or motor operated on 110 volt, 60 cycle, AC. For replacement parts, order:

Name	FSN
Belt (for foot operation).....	3030-525-4150
Belt (for motor operation).....	3030-542-1550
Controller.....	6110-542-7941

Index No. 2610—For replacement parts, order:

Name	FSN
Belt (for Ritter unit).....	3030-299-8585
Belt (for S. S. White unit).....	3030-542-1555
Belt (for Weber unit).....	3030-299-8585
	or 3030-542-1550

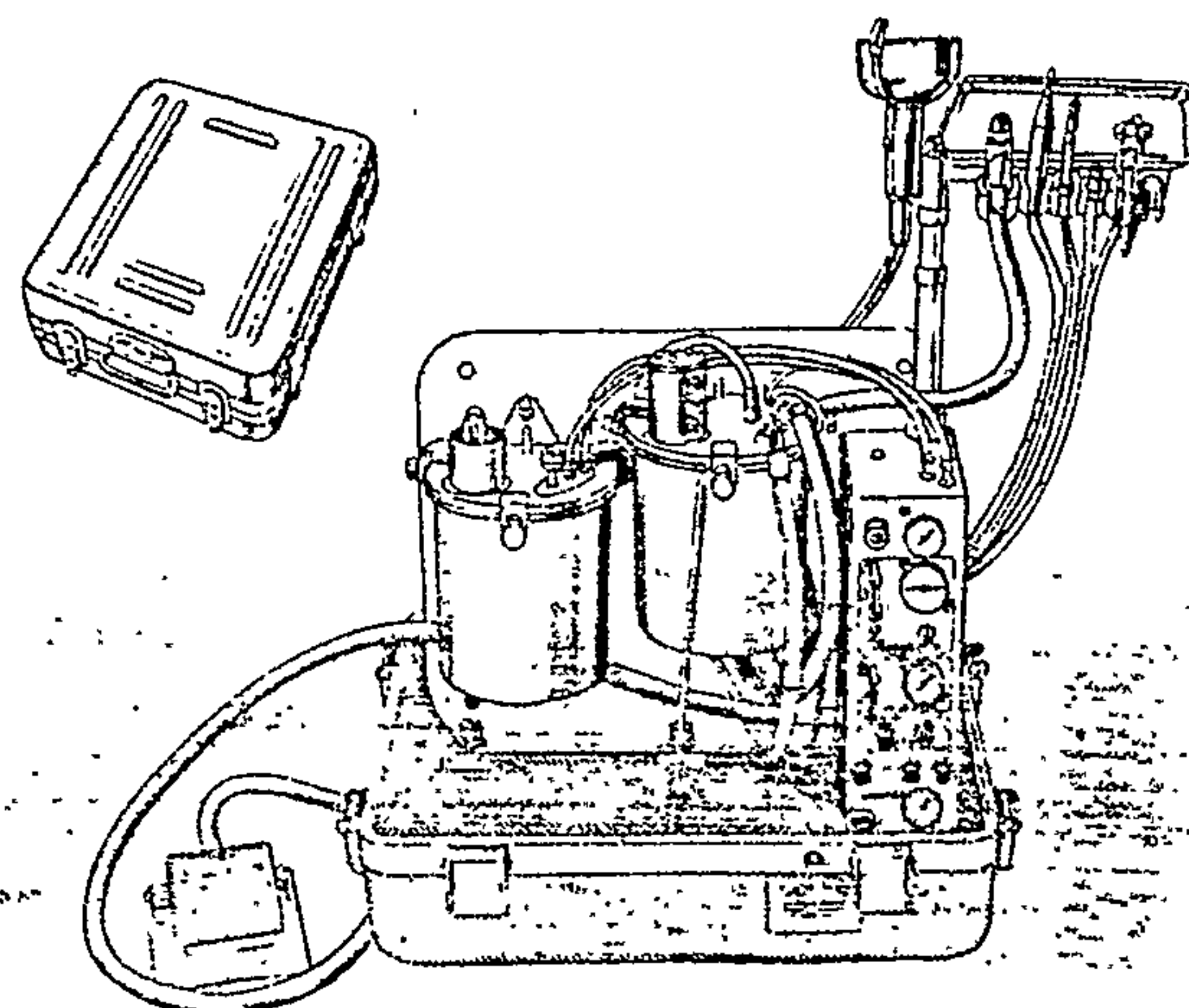
Action	Index No.	Federal Stock No.	Descriptive Data	Watts	Mounting
—	2595	*6520-525-2500	Bench Type, 110 volt, 60 cycle, AC	185	Table base
—	2600	6520-484-9494	Bench Type, High Speed, 110 volt, 60 cycle, AC	125	Table base
—	2605	*6520-525-3650	Field	150	Upright stand
—	2610	*6520-525-3008	Mobile, 110 volt, 60 cycle, AC	100	Base with casters

*For list of repair parts, see Repair Parts Pamphlet No. 159.

DENTAL OPERATING AND TREATMENT UNIT, FIELD

In carrying case. Consists of contra-angle handpiece, straight handpiece, Index No. 4340; syringe, water supply tank, out-flow collector tank, oral evacuator, saliva ejector, cuspidor, foot controller, air-water spray, tubing, fittings, valves, gages, and controls. With flexible air supply tubing equipped with quick-disconnect fittings at both ends. Used with compressor, Index No. 2275, for restorative dentistry in the field. For saliva ejector mouthpiece, order Index No. 5410.

Action	Index No.	Federal Stock No.	Descriptive Data
C	2620	*6520-930-7951	Portable, Air Operated.



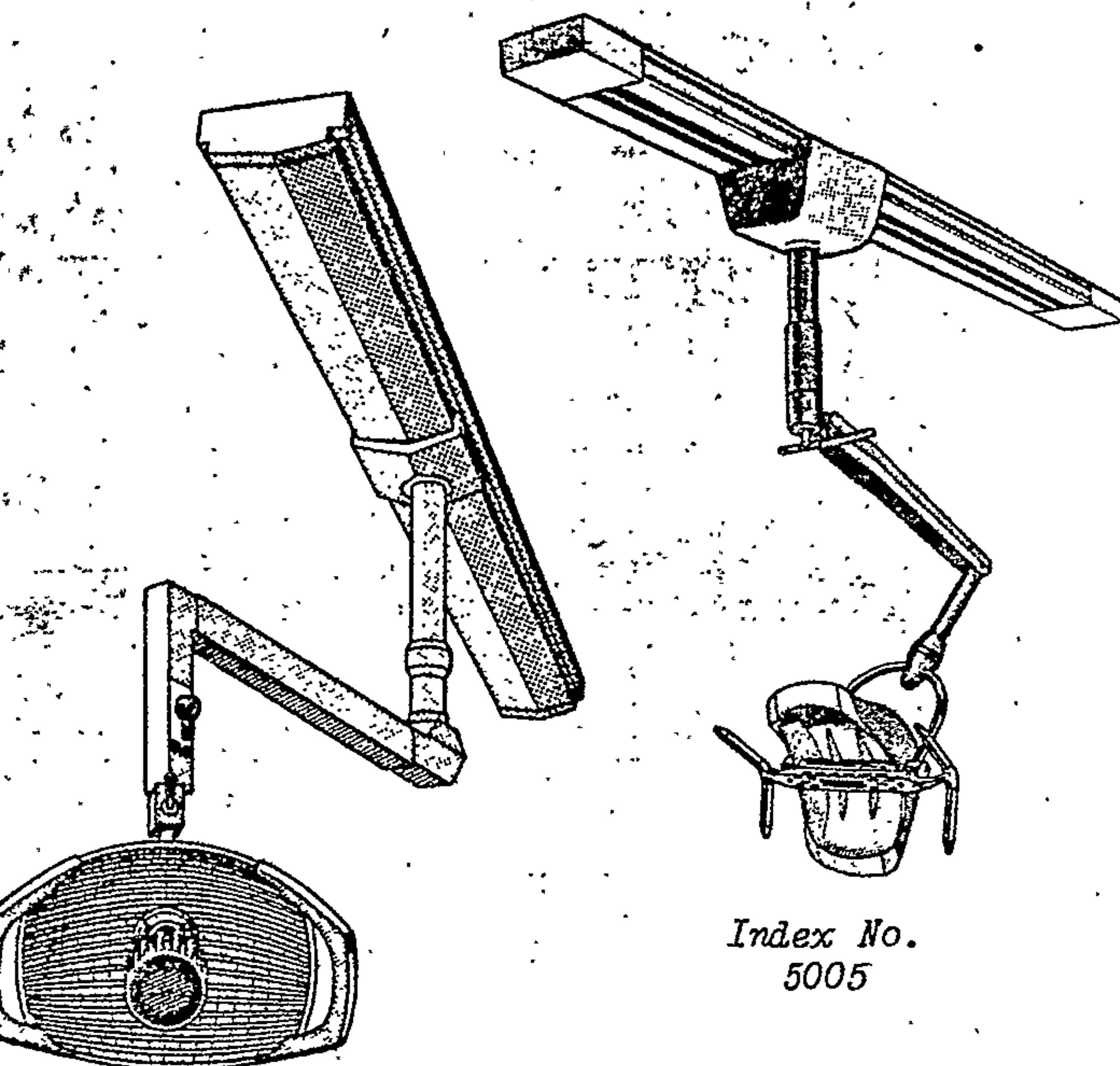
*For list of repair parts, see TM-EPSC-6520-261.

HEAD, MARKING, DENTAL SURVEYOR

3/4 in. long, 1/10 in. dia; one end beveled. For use with dental clasp surveyor, Index No. 7110.

Action	Index No.	Federal Stock No.	Descriptive Data
—	4990	6520-890-1354	6s

LIGHT, DENTAL OPERATING, CEILING



Index No. 5000

Index No. 5005

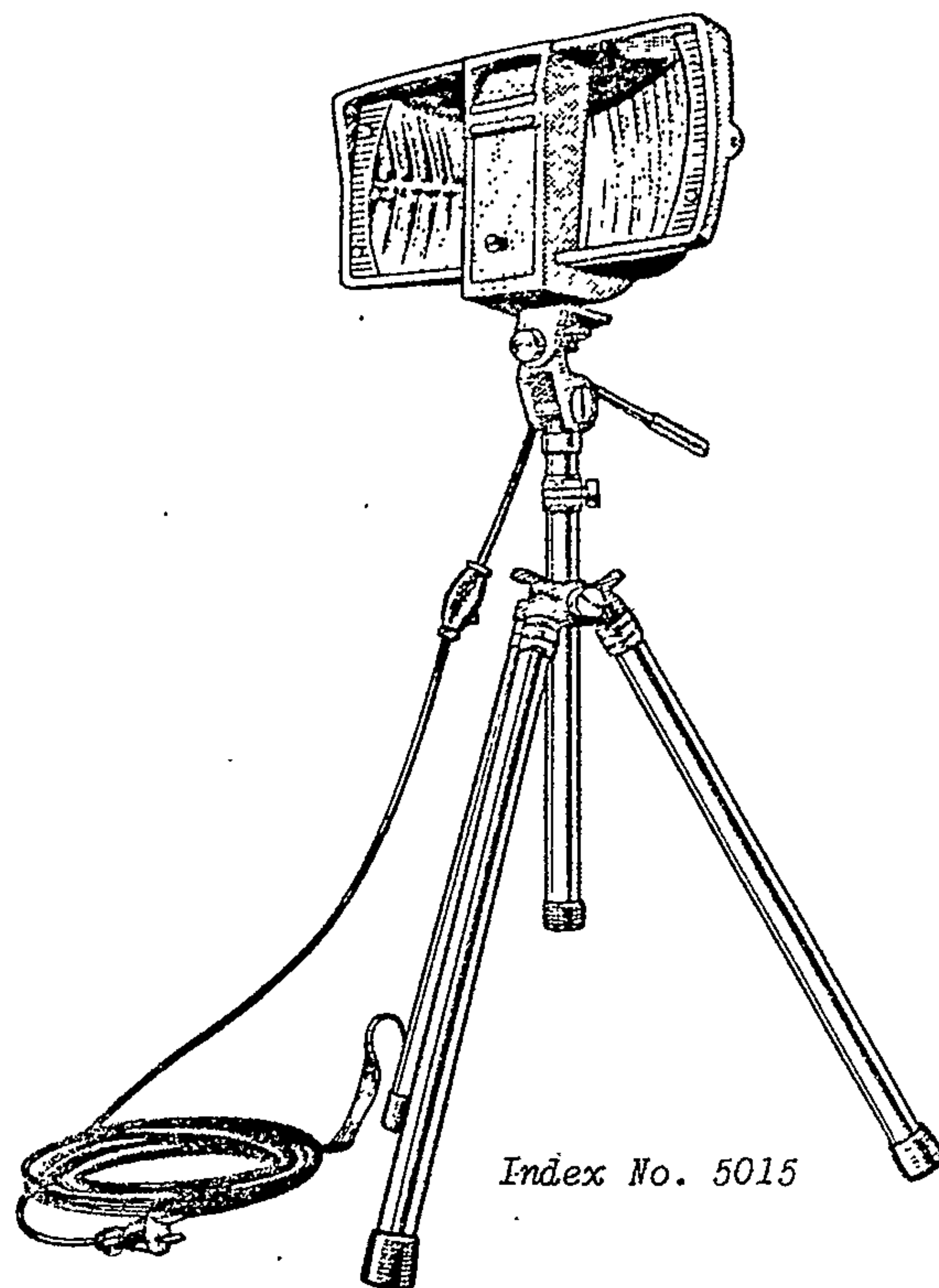
track-type suspension.

Index No. 5000—225 watts. Gray. For use in installations with a ceiling height between 8 ft and 10 ft. Requisition should state height of ceiling, electrical characteristics, and choice of single or dual light head. For replacement lamp, order 6240-183-0333.

Index No. 5005—200 watts. Blue, coral, green, heather, silver, or white. For use in installations with a ceiling height between 8 ft and 10 ft, 6 in. Requisition should state height of ceiling, choice of color, choice of single or dual light head, electrical characteristics, need for mounting kit and type required. For replacement lamp, order 6240-176-5083.

Action	Index No.	Federal Stock No.	Descriptive Data
C	5000	6520-181-7821	Reflector Type, 110 or 220 volt, 50-60 cycle, AC
C	5005	6520-890-2184	Reflector Type, 110 or 220 volt, 50-60 cycle, AC

LIGHT, DENTAL OPERATING, FIELD



Index No. 5015

125 watts; adjustable stand; with three 125 watt incandescent lamps. For replacement lamp, order \$6240-798-1810.

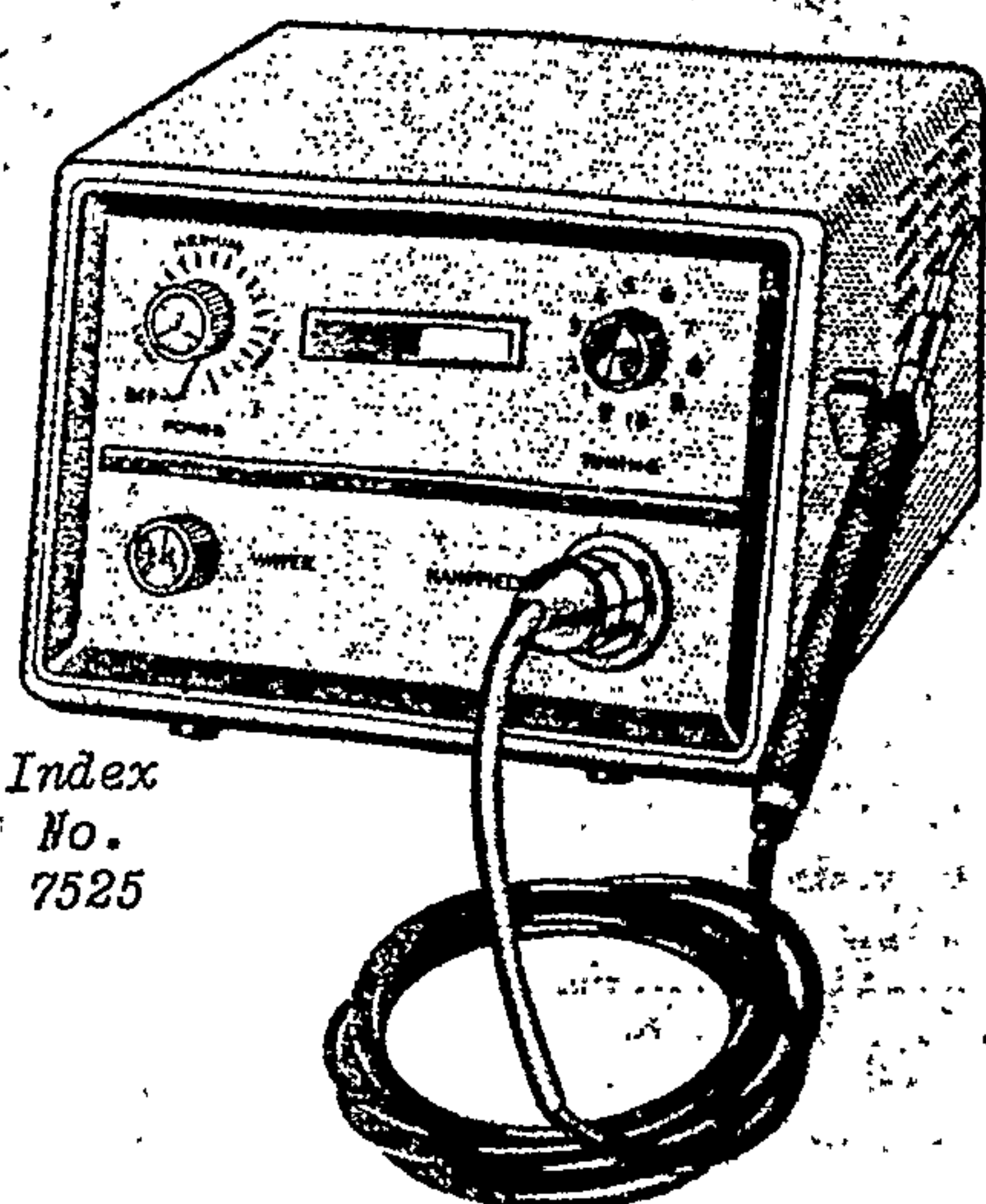
Action	Index No.	Federal Stock No.	Descriptive Data
C	5015	*6520-074-4581	110 volt, AC-DC

*For list of repair parts, see TM-DPSC-6520-234.
 \$Item not managed by DPSC. Obtain in accordance with appropriate Military Service Management Data Lists.

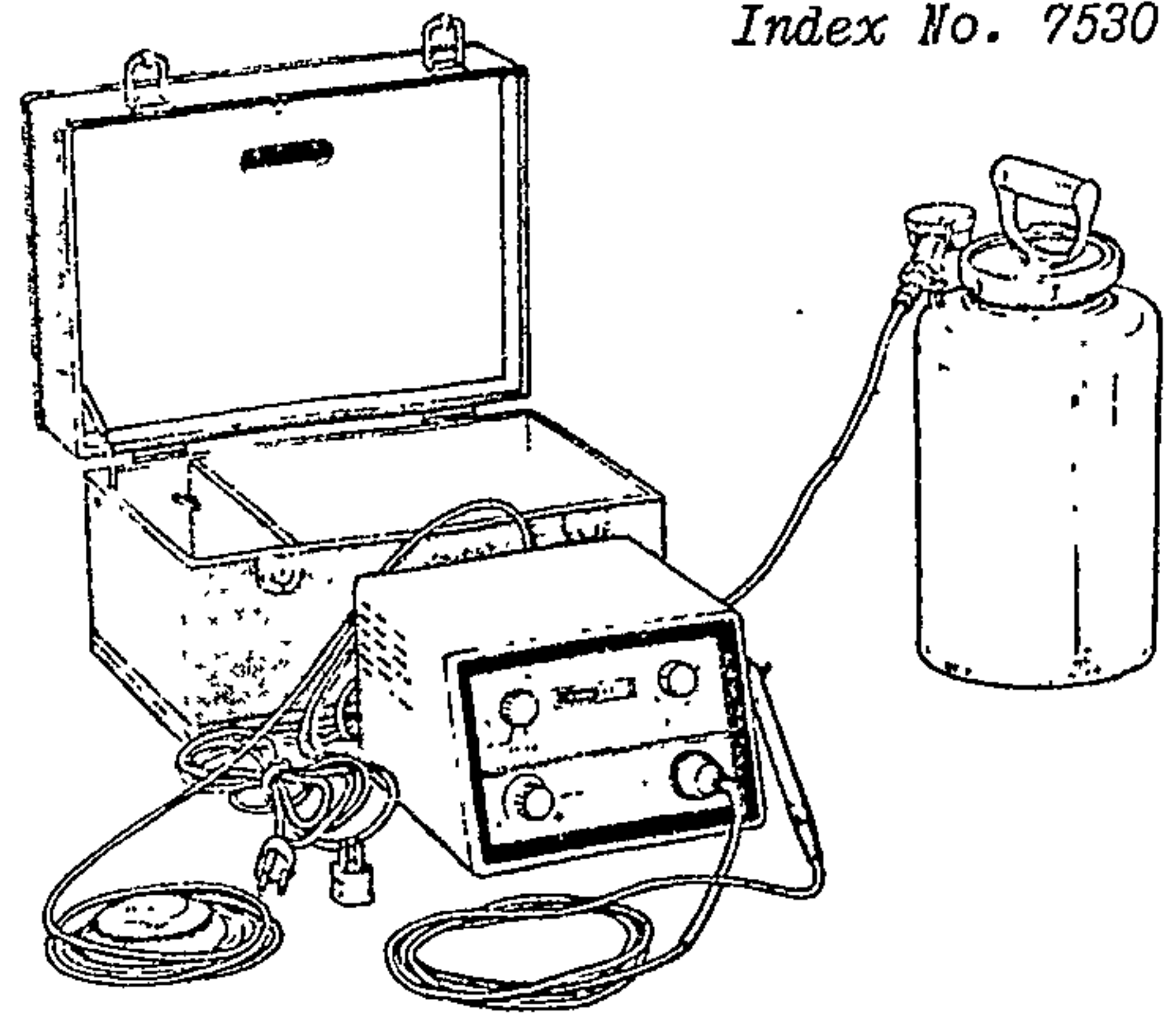
AN INDEX NUMBER GETS YOUR STOCK NUMBER

Whether it's used in an index, a cross reference, or as an illustration number, the Index Number leads you to the Stock Number that must be used for ordering.

ULTRASONIC PROPHYLAXIS UNIT DENTAL



Index No. 7525



Index No. 7530

130 watts. Consists of an electronic generator, water system housed in a table-model cabinet, handpiece assembly, and a foot switch. With the following controls:

- Dial, power selector
- Dial, tune control
- Knob, water flow adjustment
- "On" indicator

Index No. 7525—With 6 interchangeable handpiece inserts (1 each of Index No. 4805-4815, 4825, 4835, and 4840). Requisition should state name of manufacturer and specific model number of dental operating unit, in order that proper water fittings may be supplied. For capability of use where plumbing connections are not available, order water supply tank, Index No. 7235.

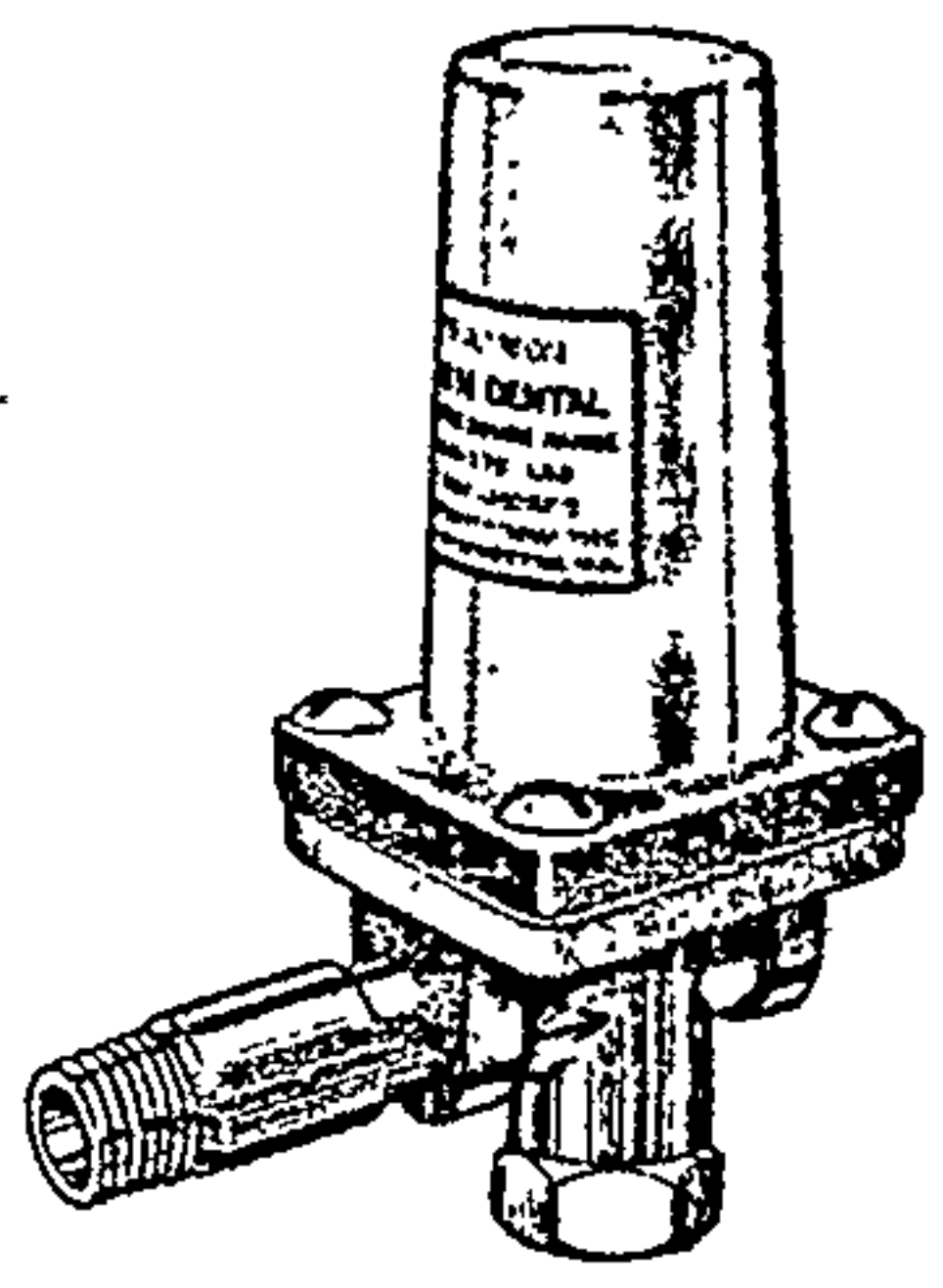
Index No. 7530—In carrying case. With 12 interchangeable handpiece inserts (3 each of Index No. 4805-4815, and 4825), and water supply tank with handpump. For replacement water supply tank, order Index No. 7235.

Action	Index No.	Federal Stock No.	Descriptive Data
C	7525	*6520-990-1584	Portable, 110 volt, 60 cycle, AC Input; 35 volt, 25 kilocycle, AC Output
—	7530	*6520-103-9747	With Water Supply Tank, Portable, 110 volt, 50-60 cycle, AC Input; 35 volt, 25 kilocycle, AC Output

*For list of repair parts, see TM-DPSC-6520-275.

VALVE, AUTOMATIC DRAIN, DENTAL

Can be installed on existing drain tap. With an accessory kit of installation fittings. For use in compressed air systems within a range from 30 to 200 psi, to drain condensed oil and water from a receiving tank having an air compressor with a min 1/2 hp motor.

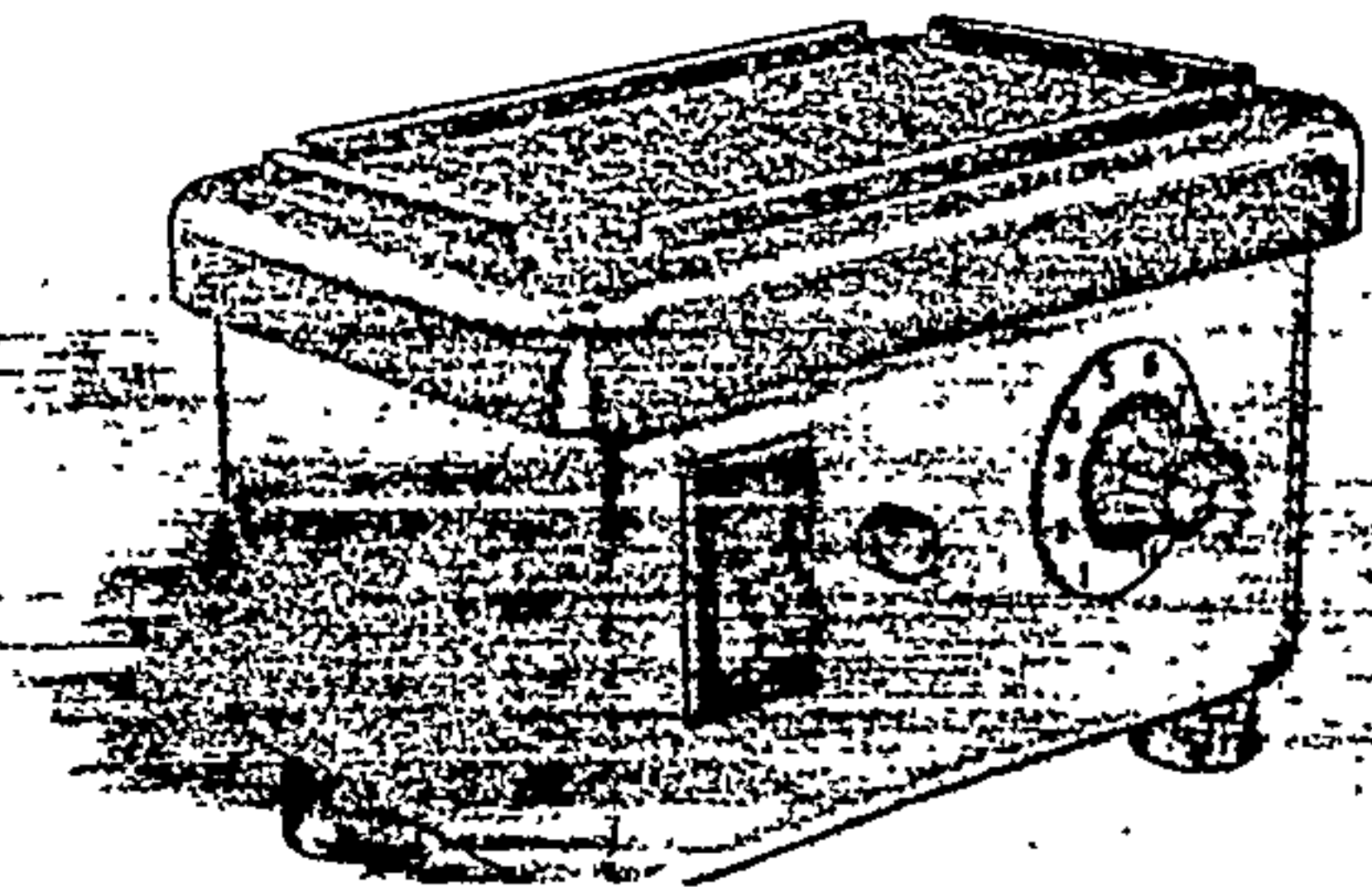


Action	Index No.	Federal Stock No.	Descriptive Data
—	7545	6520-878-4168	Moisture and Oil Condensate

VIBRATOR, DENTAL MOLDING

50 watts. With rectifier and stepless rheostat.

Action	Index No.	Federal Stock No.	Descriptive Data
—	7555	6520-962-2106	110 volt, 60 cycle, AC



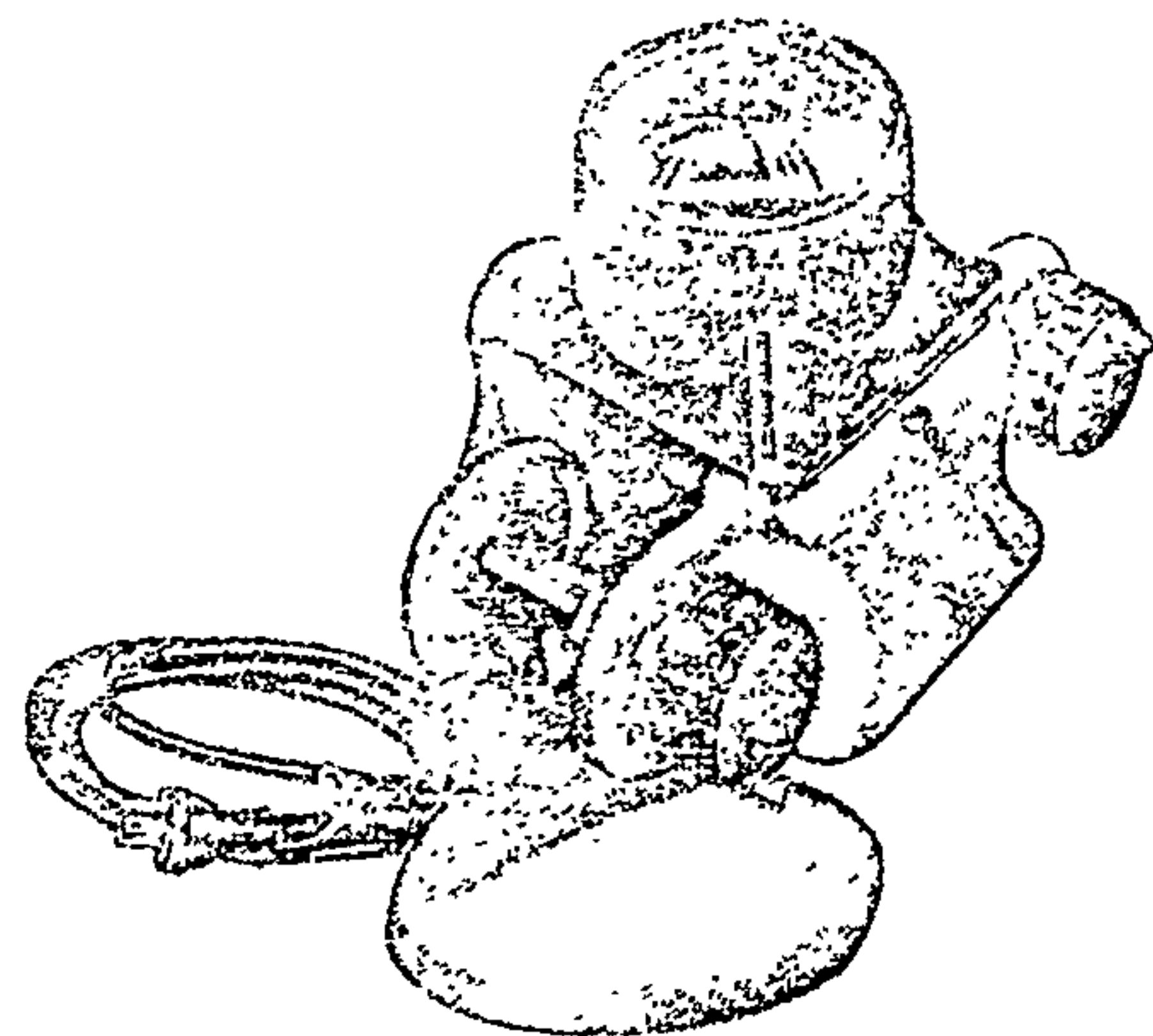
VIEWER, X-RAY FILM

8 watts. Nonstereoscopic. Magnifying lens. With two film reels: one on each end to permit film to travel in either direction. Mounted on swivel base. For replacement lamp, order \$6240-796-6240. For use with photofluorographic and roentgenographic accessory assembly, Index No. 814, and X-ray apparatus, Index No. 1365 and 1370. For viewing 70 mm photofluorographic roll film.

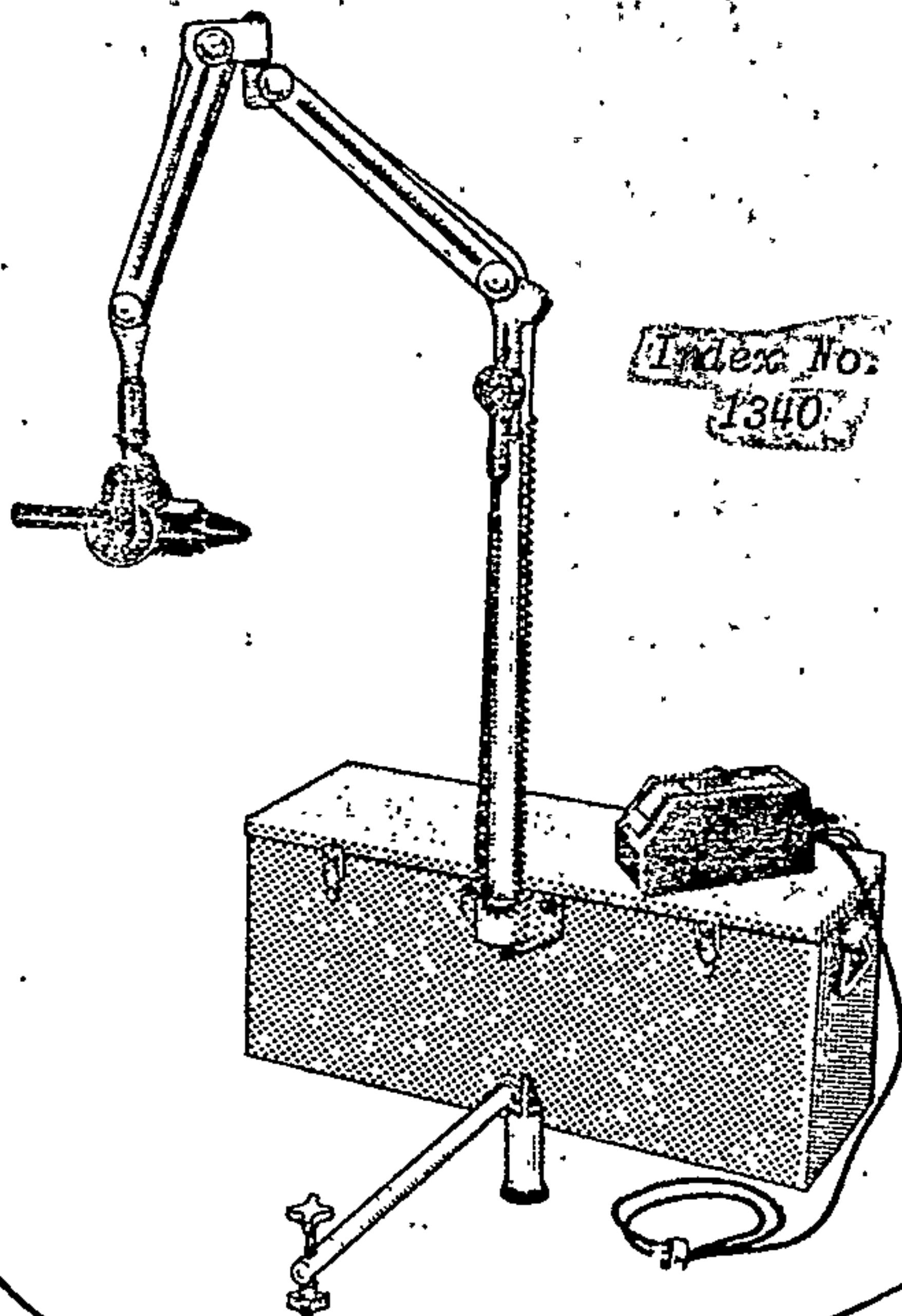
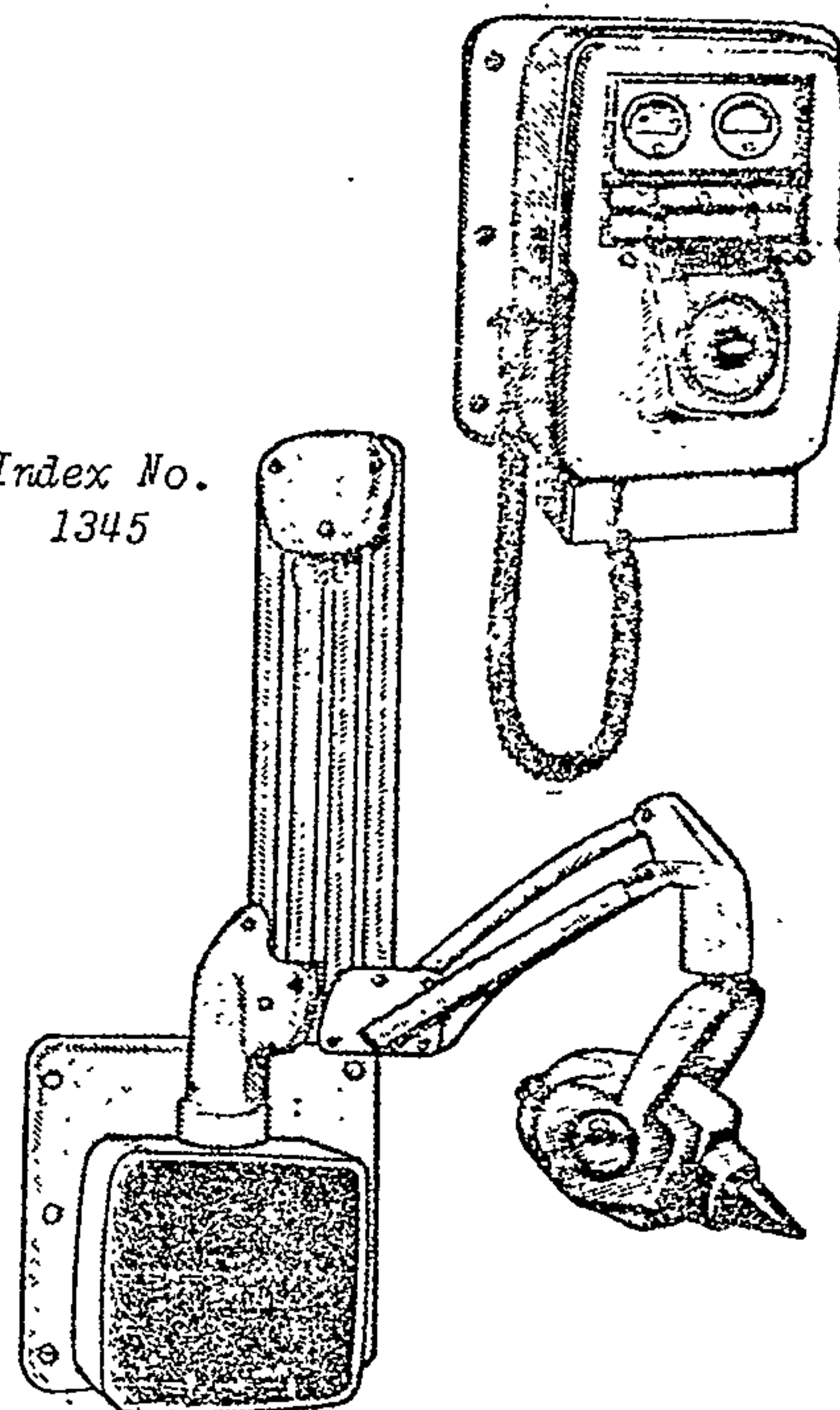
Action	Index No.	Federal Stock No.	Descriptive Data
—	1320	*6525-603-9900	Fluorescent Illuminated, 110 volt, 60 cycle, AC

*For list of repair parts, see Repair Parts Pamphlet No. 154.

§Item not managed by DPSC. Obtain in accordance with appropriate Military Service Management Data Lists.



Index No. 1320

X-RAY APPARATUS, DENTALIndex No.
1340Index No.
1345

Index No. 1335—2400 watts. Panoraphic. Blue, coral, green, silvertone, tan, or white. Consists of motor-driven chair with chin support assembly mounted on movable metal base; wall-mounted control unit and chassis that bolts to wall and floor; vertical column assembly supporting rotating horizontal arms with cassette holder and X-ray tubehead assemblies. For replacement cassette, order Index No. 105; for replacement tube-transformer head, order Index No. 1245. The choice of color should be stated in the requisition.

Index No. 1340—800 watts. With tubehead-transformer mounted on folding extension bracket, timer, control unit, and two dental radiographic cones. Mounted on carrying case.

Index No. 1345—2100 watts. Single control capable of operating more than one X-ray tubehead. With wall-mounted control unit separate from wall-mounted folding bracket-tube arm-tubehead assembly, and radiographic cones. For interconnecting cable, order \$6145-889-1146.

Action	Index No.	Federal Stock No.	Descriptive Data
—	1335	6525-222-1340	Floor Mounted, 10 MA, 90 PKV, 110 volt, 50-60 cycle, AC
—	1340	*6525-690-3214	Portable, 7 MA, 50 PKV, 110 volt, 50-60 cycle, AC
—	1345	†6525-975-2509	Wall Mounted, 15 MA, 90 PKV, 100-130 volt, 50-60 cycle, AC

*For list of repair parts, see TM-DPSC-6525-230.

†For list of repair parts, see TM-DPSC-6525-252.

§Item not managed by DPSC. Obtain in accordance with appropriate Military Service Management Data Lists.

11. ERGONOMICS AND WORK SIMPLIFICATION WITH
PORTABLE DENTAL EQUIPMENT

Ergonomics may be defined as the scientific study of the relationship between man and his working environment. The principles of dental ergonomics are based on the desire to combine the health and well-being of the dentist together with his efficiency. (61)

Human engineering means engineering for human applications. More specifically human engineering is defined as follows: the design of human tasks, man-machine systems and specific items of man-operated equipment for the most effective accomplishment of the job, including displays for presenting information to the human senses, controls for human operation and complex man-machine systems. In the design of equipment, human engineering places major emphasis upon efficiency as measured by speed and accuracy of human performance in the operation of the equipment. Allied with efficiency are the safety and comfort of the operator. By considering sensory capabilities, intellectual abilities, capacity for learning new skills, capacity for team or group effort and the understanding of body dimensions, human engineering ultimately reduces the problem of training personnel, providing more effective utilization of personnel, producing the amount of effort to perform the task involved. (62)

Certain "principles of motion economy" should be considered. The ease, speed and accuracy of manual operations may be increased by the application of motion-economy principles.

- a) The motion sequence that employs the fewest basic divisions of accomplishment is the best for performing a given task.

- b) Hands should be relieved of all work that can be performed more advantageously by the feet or other parts of the body.
- c) Tools, materials and controls should be located in an arc around the work place and as near the worker as possible.
- d) Tools and materials should be pre-positioned in order to eliminate searching and selecting.
- e) Two or more tools should be combined whenever possible.
- f) The height of the work place and the chair should preferably be so arranged that alternate sitting and standing at work are easily possible.
- g) Continuous, curved motions are preferable to straight-line motions, involving sudden and sharp changes in direction.
- h) Rhythm is essential to the smooth and automatic performance of an operation and the work should be arranged to permit easy and natural rhythm whenever possible.
- i) Successive movements should be so interrelated that one movement passes easily into the next, each ending in a position favorable for the beginning of the next movement.
- j) Hesitation, or the temporary and often minute cessation of motion should be analysed; its cause should be accounted for and, if possible eliminated.

The single fact that the dentist works on a living person, with all the variations which this entails is sufficient to differentiate the work of the dentist. Dentist's motions are regulated by the treatment situation and the required instrumentarium. (63)

In Vol.2, Plate 15 shows an example of a poor ergonomics situation. Dentistry is being performed in the sick bay of a warship with portable equipment. Examination of this photograph will bring out the need for the implementation of ergonomics principles.

From 1935 to 1955, no major change occurred in the dental unit, chair, or operating essentials. With the introduction of high and ultra-high speeds in 1955, definite changes

began in, not only equipment, but also mode of practice. Since 1955 dental units have shown major changes every year. The profession is indebted to such men as Richard Page, John Borden, and others who helped make ultra-high speeds in dentistry possible. Two more innovations introduced about the same time as ultra-speed equipment have also furthered functional operating. Elbert Thompson introduced washed-field dentistry and John Anderson the use of a contour configuration chair. These three factors helped open up a new concept of dental operating. (64)

The dentist is the victim of modern day emphasis on reduced and simplified motions. To ensure sufficient physical activity, a re-evaluation of motions and stresses involved in performing operative dentistry is urgently needed. The most effective way to establish physiologic work habits probably is to orient the dental student to assume his proper role in work simplification developments for his health and well-being take precedence over production.

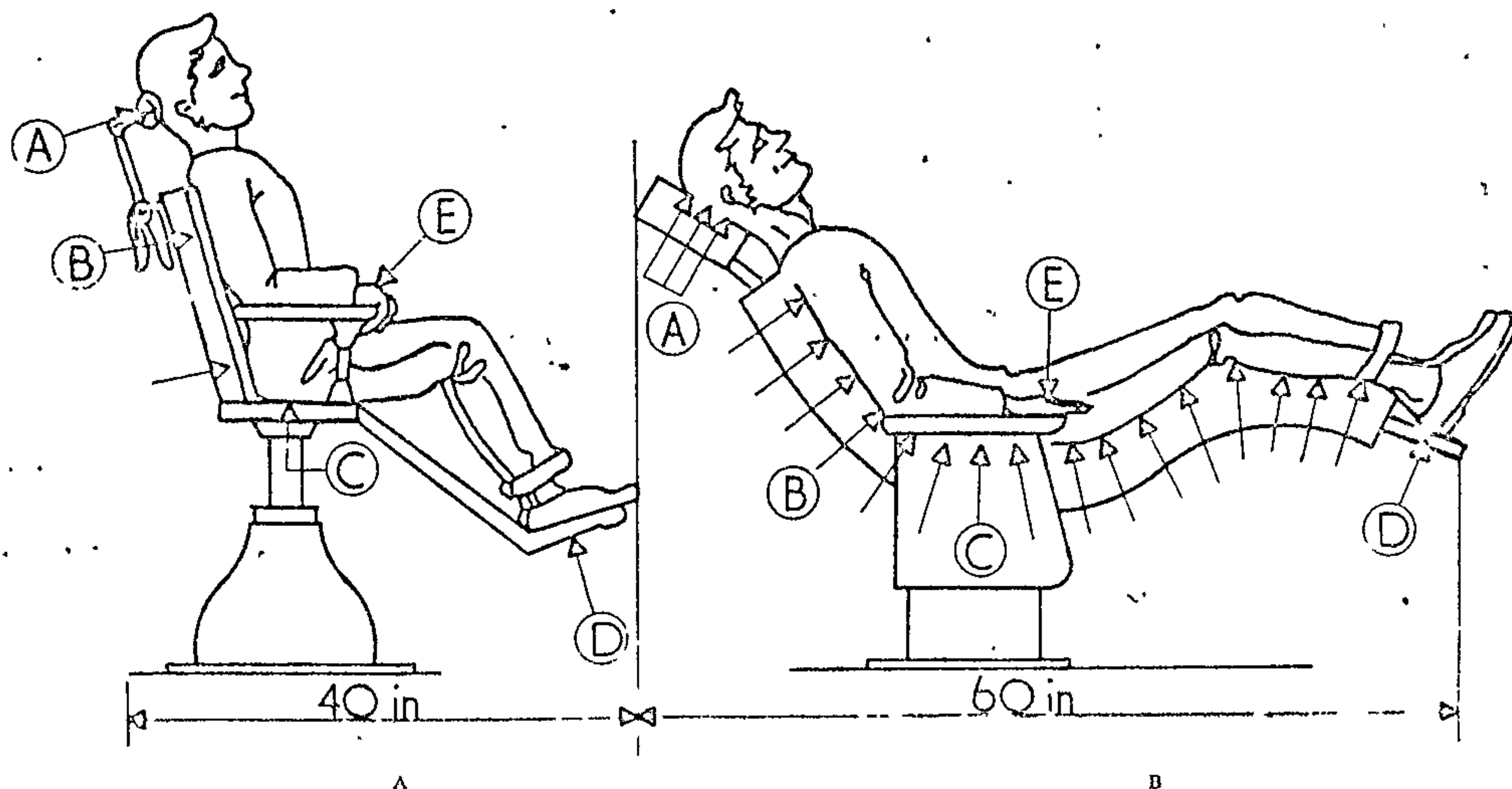
One problem is assessment of the effects of improper use of the body on tension and fatigue. It must be known how dentists use their bodies in performing operative dentistry, whether they stand or sit, the positions they assume and the period they hold these positions and their manner of holding tools. From these, it should be able to learn the long-range effects of good and bad work habits on general health. Dentists are urged to practice in an efficient manner by planning tool and equipment placement to minimize physical effort. Yet, it is believed that efficiency connotes consideration of healthful body mechanics and physical fitness also. Immobilization is dangerous and heralds a generation of dentists who may be physically unfit and more susceptible to coronary disease than if they were more active in their working habits. (65)

A Dentist's posture includes his particular body arrangements; the way his limbs and head fit his trunk; their alignment in lying, sitting, kneeling and standing, and their stabilization while one or more parts move.

Figures 69 - 75.

Instruments and machines are made for man, not man for the machines. Our equipment should make our work easier and help us produce better results. It should not be a substitute for understanding and human value. Good planning will eliminate tiresome movements such as reaching at arm's length, stooping down, turning round etc. On the other hand, it must not be forgotten that prolonged immobility may tire the operator and make him nervous. (66)

Although equipment will always be changing, the principles of effective use and motion economy will change very little, and these are the principles on which the practitioner should base any consideration of change in equipment. Some older procedures, such as the use of rubber dam, are actually a work-simplification aid and make functional operating easier. Combining functional operating equipment with other work-simplification procedures, such as pre-prepared tray systems, good traffic flow, well-trained auxiliary personnel, good lighting, overall efficient practice management, and a mastery of operative techniques will bring rewards of high-level production along with an easier work day, sustained production for a longer work life, and what is perhaps most important of all - better dental care for the patient. (67)



- A. Single point head support (fatigued neck muscles).
 B. Unequal back support (fatigued back muscles).
 C. Single point seat support.
 D. Foot support=pressure tension.
 E. Hand grip=pressure tension.

- A. Complete head support.
 B. Equal body weight distribution.
 C. Complete body support=relaxation.
 D. Heel support=no pressure tension.
 E. Arm support=no pressure tension.

FIG. 69.—Positions of the patient: A, patient fatigue occurs within 7 to 30 minutes when patient is upright; B, minor fatigue indications are present after 3 to 4 hours when the patient is in a semi-supine position. (From Golden, 1959.)

Figure 69.



Fig. 70 • Composite sketch of subject in head-down position with cervical spine bent forward, rounded upper back and hunched shoulders seated on edge of high stool. Only two features are good: knees are together and elbows are low

Figure 70.



Fig. 71 • Subject is seated on edge of high stool and straddles patient's chair. Base is wide and ineffectual with toeing out and eversion of left foot

Figure 71.

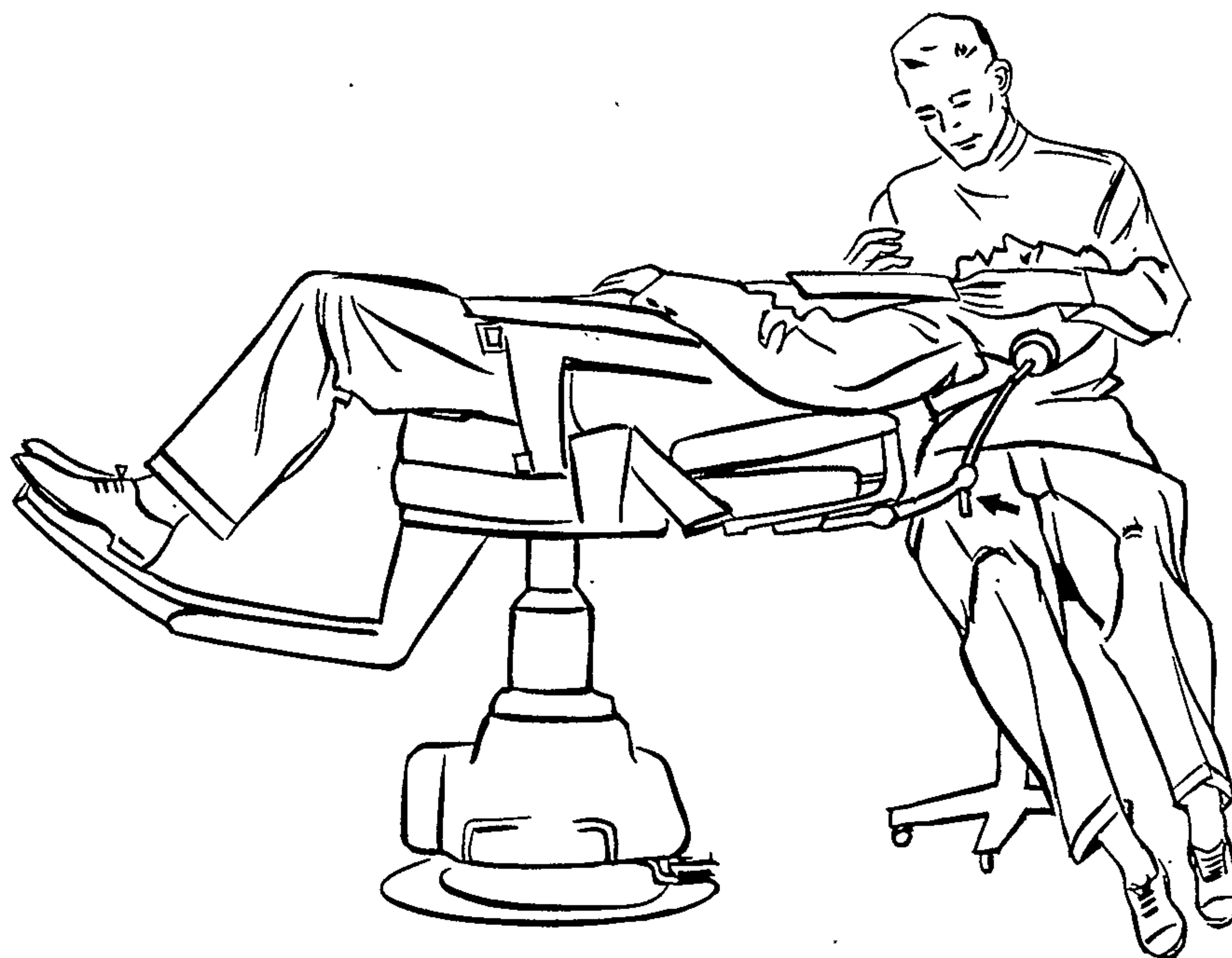


Fig. 15 • Dental chair with conventional adjustments. Back rest and chair base do not give room for dentist's thighs and knees, although dental stool is low enough, in this case

Figure 72.

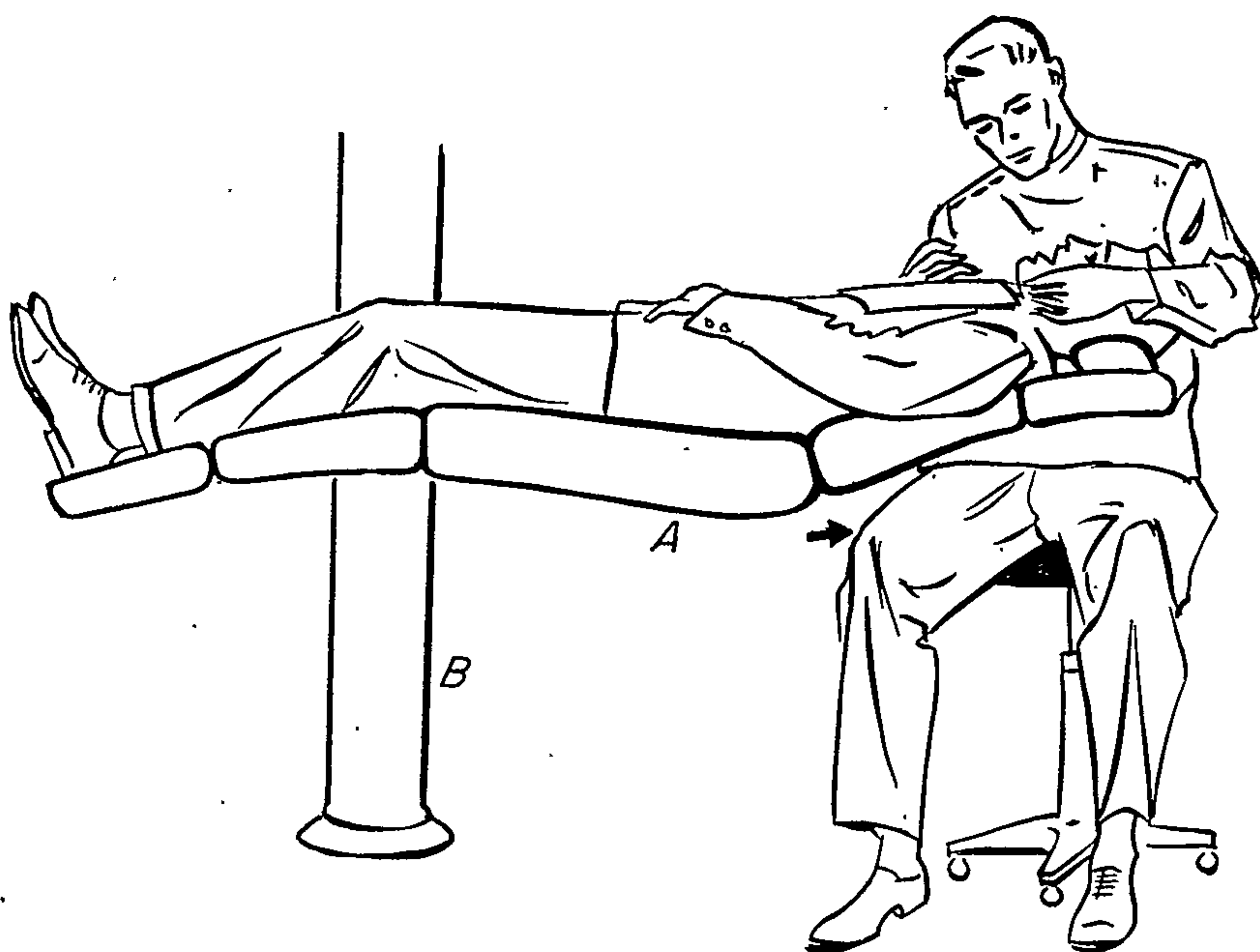


Fig. 16 • Pointers for new design of dental chair. A: Thin, streamlined construction without interfering levers. B: Column with hydraulic lift located away from dental work. Note freedom of knee and thigh areas. In drawing, stool is too high for proper sitting; it should be lowered to height of lower legs

Figure 73.



FIG. 2

Optimum Work Areas of Operator and Assistant with Overlap.

Figure 74.

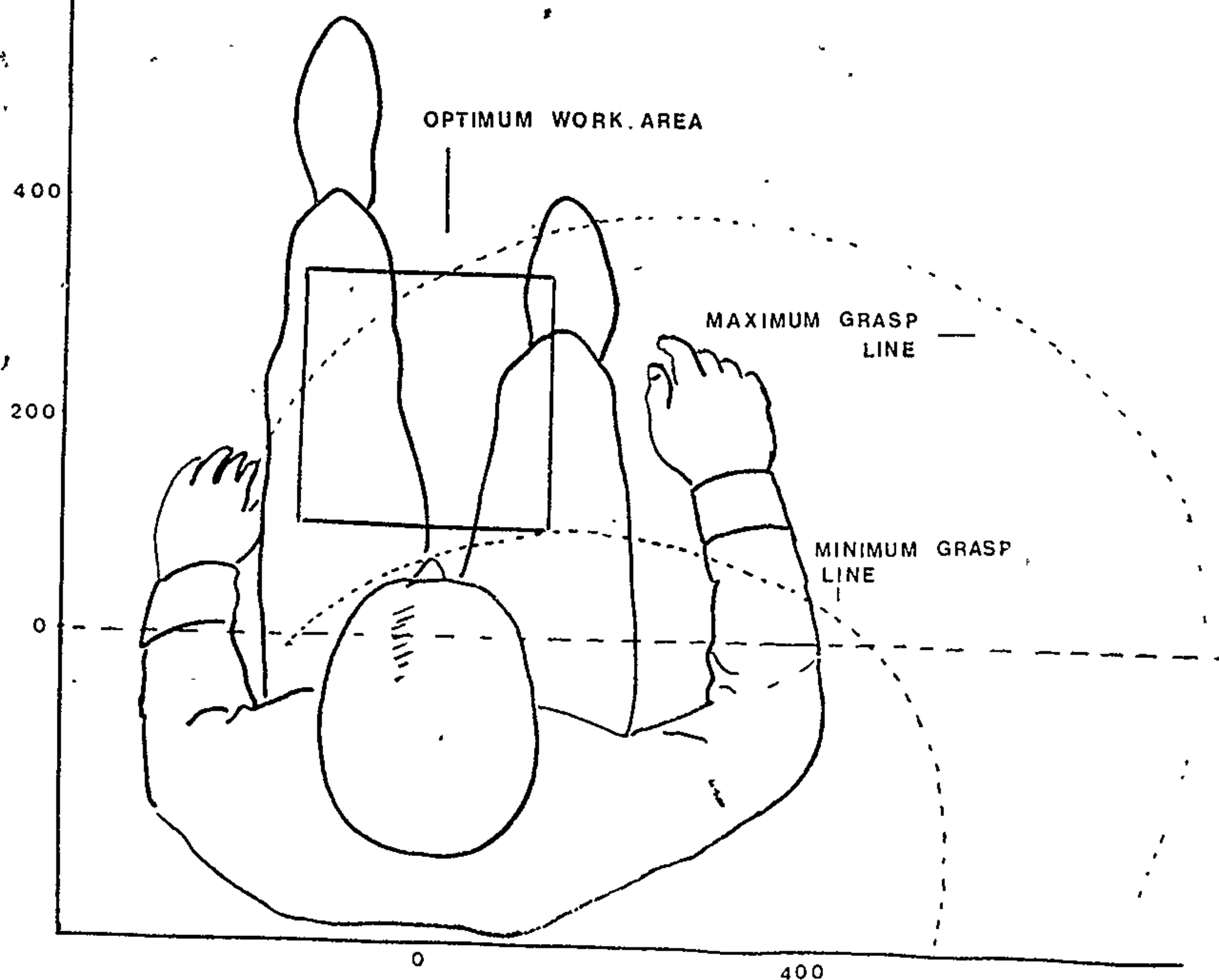


FIG. 4

Optimum Work Area and 'Grasp Lines' for the Seated Operator.

Figure 75.

12. CARE AND MAINTENANCE OF PORTABLE DENTALEQUIPMENT

Because of the mobility of portable dental equipment, the servicibility factor is much lower than with conventional static equipment. Therefore any care and maintenance schedule must be of a very high standard in order to retain maximum servicibility of portable equipment in the field.

A simple and comprehensive service routine can be built up, around five headings, in the following way:-

- 1) Keeping equipment clean - on grounds of hygiene, if for no other reason, most dentists are careful to ensure that, externally, their surgery equipment is kept scrupulously clean. The finish should be wiped down at the end of each day; any water, organic matter or splashes of chemical products being carefully removed. Since some of the chemicals used in dentistry can be positively harmful to enamelled surfaces, it is a useful further precaution to arrange for the finish to be washed down periodically - say once a week - and for the major items of surgery equipment to be polished, with a suitable protective product, at least once every month.

Great care should be taken to ensure that the water and waste plumbing of the unit is kept clean since these are the areas most subject to blockage and corrosion. As part of the daily routine, the cuspidor waste-trap and saliva ejector filter should be cleaned (do not empty the waste-trap down the cuspidor drain - this is defeating the purpose) and all pipes and tubings flushed copiously through with fresh water.

High-volume aspirators and saliva ejectors are particularly susceptible to the accumulation of organic waste - a particularly unpleasant slime can build up as a coating inside the tubings and waste-receptacles- and these can best be dealt with by sucking through a generous measure of some suitable disinfectant after flushing through with water. However, since plastics and the various grades of rubber used in dental equipment are affected in different ways by these chemicals, it is vital to ensure that only the particular disinfectant recommended by the manufacturer of the equipment is used for this purpose.

Spray bottles, tumbler stands, instrument trays and similar items can simply be washed in the sink while metallic instrument nozzles, saliva ejector tips, etc., will normally be sterilized. Since plastics are becoming more widely used (in, for instance, combined syringe nozzles) it is a wise precaution to check with the manufacturers' instructions precisely which methods of sterilization are permissible. The gas burner should be cleaned periodically and, if difficulty is encountered in removing accumulated wax, the entire assembly can usually be lifted off (or unscrewed) and immersed in boiling water.

The procedure for cleaning turbine and engine hand-pieces, amalgam packers and similar special-purpose tools varies considerably from make to make. The manufacturers' instructions for cleaning and lubricating these instruments should be followed carefully.

Apart from the unit, with its plumbing systems, aspirator and instrumentation, few other items of surgery equipment need anything other than external cleaning. The operating light should be dusted daily and, if it is

of the enclosed type, the reflector may need cleaning at intervals of 4-6 weeks (a non-abrasive cleanser should always be used for this purpose). Cleansing of other, more specialised items, such as the X-Ray apparatus and the sterilizer will be dealt with separately in other articles in this series.

2. Keeping the equipment lubricated - Most types of dental unit have many moving parts - cuspidor arm, bracket table, engine pivot, etc. - but lubrication of these points is not usually required at frequent intervals and is best left to the service engineer because it is often necessary to dismantle the equipment to gain access to the bearings. Occasionally one of these joints may run dry and become obtrusive by squeaking or failing to move smoothly. In these cases it is sometimes possible to lift the offending member and apply a light smear of grease to the bearing surfaces without actually taking the unit apart. Apart from such simple first-aid measures lubrication of the unit is generally confined to the engine and the cord-drive arm.

On the engine, there are generally two oiling-points - one at each end of the armature shaft - and the cord-arm usually has oil points at each set of pulleys. These points should be wiped clean of discoloured oil and sludge and relubricated in accordance with the manufacturers' instructions as to frequency and grade of oil. Engine handpieces, like other instruments, should be lubricated strictly in accordance with the makers' instructions. Often, a different grade of oil is recommended for this purpose.

Other items of surgery equipment - chairs, stools, etc., need little lubrication (unless particularly specified by the manufacturer) but, like a bicycle, a light smear of some suitable oil (3-in-1 oil, for instance) can be applied to parts which start to squeak. Never apply oil or grease to locking mechanisms unless this is particularly specified by the manufacturer.

3. Topping up with oil and water - Most types of unit contain one or more oil-mist lubricators as part of the low and high speed handpiece circuits. These oil reservoirs must be checked regularly and topped up with the correct grade of oil when necessary. If, in error, the oil has been allowed to fall below the minimum level mark on the glass container, it is strongly recommended that the remainder be thrown away and that the reservoir be cleaned and refilled with fresh oil. If the surgery gets very cold at night, it is a wise precaution to check that the oil has not solidified in the reservoir. If, for this or any other reason, oil is prevented from reaching the handpiece bearings, the instrument could be seriously damaged within a very short time.

It is usually convenient to check the unit air filters at the same time as the reservoirs and the moisture collecting in these should be drained off regularly. Some modern units have self-draining regulators but even these should be inspected occasionally to ensure that the dumping valve is working correctly.

It is not usually advisable (or necessary) for the dentist to top up the hydraulic circuits of, for instance, a motorised dental chair. This work should be left to a qualified service engineer who should be

consulted immediately any leakage or malfunction of this type of equipment is observed.

4. Replacing wornout parts - The watchword here is vigilance. It is better to replace parts showing signs of wear at an early stage, rather than to permit them to become completely unserviceable, since this saves consequent wear and tear on associated components. A badly worn hand-piece insert can, for instance, ruin a hand held motor just as letting the brushes of a conventional engine wear right away can necessitate replacement of the whole armature assembly. Parts which wear out are nearly all associated with the power-operated instruments and the fact that they are in need of replacement will soon force itself upon the dentist's attention by the lower standard of performance obtainable from the instrument. Engine belts, air turbine heads, operating light bulbs, etc., are all easily replaceable items and, without too great an investment, the dentist can ensure continuity of work by holding a spare. It is not recommended that the practitioner should replace such items as engine brushes or cord-arm pulley wheels himself since these components generally require a degree of specialised fitting (brushes need to be correctly bedded down on the commutator, for instance) and are best left to the trained service engineer. The same can be said of the brushes on aspirator and hydraulic pump motors and of the heating elements found in units, handpieces and syringes (except where these are specifically designed for replacement by the dentist).

5. Preventive Maintenance - Conscientious performance of these simple maintenance procedures will be found to eliminate most of the minor service troubles with which

even the most expensive surgery equipment can be plagued. Regular maintenance can be combined with routine checking of the various services and ancillaries and it is strongly recommended that even if some member of the staff is delegated to carry out the work the surgeon himself should inspect the equipment, say, once each month, to ensure that no part of the procedure is being overlooked. During this monthly inspection, it is a good idea to work all of the movable parts of the equipment - cuspidor arm, bracket tables little-used chair adjustments, etc., - through their full range of movement to ensure that they work freely and smoothly. All switches and valves should be operated to guard against corrosion and seizure, the chair should be pumped up to full height from the lowest position to coat the cylinder walls with oil, and a quick inspection made of the inside of the unit to guard against leaks or undue wear on those parts of the retraction systems inside the pedestal, etc. Prevention is undoubtedly better (and cheaper) than cure and many problems can be nipped in the bud simply by keeping an eye on those parts of the equipment normally hidden from view. (68)

A basic schedule covering all of these tasks might read as follows:- Daily Maintenance (evenings)

1. Clean and dust all equipment including outside of lens of operating light.
2. Clean waste trap and flush bowl. Do not empty waste trap into cuspidor bowl.
3. Clean saliva ejector filter and flush tube with clean water.
4. Drain air filters if not of the self-dumping type.

5. Flush through aspirator with clean water and wash out collecting bottle. (It may be permissible to add disinfectant to the water but the manufacturers' instructions should be followed in this respect).
6. Clean and oil handpieces and instruments in accordance with the manufacturers' instructions.

Weekly

1. Oil engine bearings and engine arm pulleys.
2. Inspect oil-mist lubricators and top up, if necessary.
3. Inspect compressor oil-level and drain tank and moisture separator (if fitted).
4. Wipe down unit - particularly the cuspidor arm area - with damp cloth.
5. Clean operating light lens and reflector if necessary.

Monthly

1. Clean and polish all enamelled and plated surfaces with a suitable non-abrasive product.
2. Operate all movements of unit, light, etc., through full range to guard against seizure.
3. Operate all switches and valves.
4. Pump chair up to highest position and allow to descend to lowest position.
5. Make visual inspection of interior of unit, mobile equipment, etc.

Correction of Faults of Airotors.

<u>Fault</u>	<u>Cause</u>	<u>Correction</u>
The speed of the turbine drops suddenly (audibly noticeable by change of pitch)	Water in the turbine Turbine angle handpiece not correctly connected to tubing	Retighten union nut while instrument is running
	Faulty turbine tubing	Renew turbine tubing

	The ball bearings of the turbine angle handpiece are not sufficiently provided with oil mist	Blow against mouth mirror with turbine angle handpiece without head. A greasy deposit should appear. Check oil supply from mist oiler.
	Decrease of the quantity of air and the air-pressure resp.	Check air supply
	Faulty ball bearing	Renew turbine head according to Instruction for Use
	Screw connections of turbine angle handpiece have become slack	Firmly re-tighten screw connection while instrument is running
Spray cooling does not work	Water supply interrupted	Check water supply from unit to turbine angle handpiece
	Spray tap on turbine angle handpiece closed	Open spray tap by turning to the left and adjust spray
	Blocked spray nozzles	Pierce with cleaning wire 0.3mm and blow through the nozzle attachment in accord

-ance with
Instructions
for use

The selection of portable equipment should consider the ruggedness of the equipment as well as ease of obtaining spare parts and replacements and also the ease of access to the working parts, plumbing etc. Vol.2, Plate 67 shows the modern concept of unit design in order to give ready access to the interior working parts. Also manufacturers have made units so that whole sections may be removed and replaced in toto, for ease of maintenance. Plate 68 shows a Kavo portable unit with disassembled part.

Manufacturers issue "trouble-shooting" manuals, and daily, weekly, and monthly maintenance schedules with all their equipment. Staff should be instructed to follow these, in order to give the maximum life and serviceability for the equipment. An example of this has been given.

13. FUTURE TRENDS AND DEVELOPMENTS

Dental equipment, in many ways, can be likened to the aircraft industry, for in its passage from drawing board design to operational use, it may well become obsolete.

It has been prophesied that the chair of the future will also be the unit. There is no need for a separate "Christmas Tree" hung with a variety of equipment all relatively inaccessible. (69) The "Christmas Tree" effect has been lessened by the use of the air-powered or small-motor powered high-torque handpiece which eliminates the need for belt-driven equipment. Even small belts in some straight air-turbines are being eliminated by planetary drives and air motors. Quieter air-bearing contra-angled handpieces will become smaller and will perform with greater torque at lower speeds.

Electronic control will further reduce the noise level by minimising the need for noisy idle speeds. When more torque is required by pressure on the tooth, the turbine will go up in speed not down.

Coolant sprays will be more effective because of finer atomisation with constant volume and more power to drive through the void created by the spinning bur.

With the introduction of better chucks, locked holding mechanisms, and the use of titanium and other long-lasting materials, cutting tools will last longer and give smoother and finer cuts. Controls for all cutting equipment will be automatically activated by lifting the turbine of choice. Better balanced foot controls will be mandatory.

High-velocity suction sources are becoming standard equipment and will become quieter and easier to maintain.

It may be possible that "power packages" such as cylinders with highly compressed and replaceable gases, can be used to power equipment. Mobile cabinets will bring the more frequently used items to the chairside and will be of a more functional design. Powered cabinets will reduce the efforts required to pull them into position.

Contour configuration chairs will have thinner and more adjustable backs which can be reduced or lengthened. Head-rests for these backs can be of an offset triangular type. Vol.2, Plate 33.

Intra-oral lighting can be improved by having two overhead lights directed from front and rear. New developments are taking place in the use of intra-oral fibre-optic lighting as shown in Vol.2, Plates 54,55,56.

It may be that in the future, LASER beams may be harnessed and controlled for dental use. This possibility has already been investigated. (70)

While equipment will always be changing the principles of ergonomics and work-simplification in the use of this equipment will vary little.

14. CONCLUSION

There can be no real conclusion to the story of portable dental equipment for it is an ever continuing process of improvement and advancement. A proverb has said that "one picture speaks a thousand words". An examination of Vol.2, Plate 1 and a comparison in detail with Plate 76 will show what amazing advances have taken place from 1944 to 1972 - a span of only 28 years.

The change has not only been in the equipment itself, but in the whole concept of providing a portable or mobile dental service. Principles of work simplification, of environment, of ergonomics have all been considered.

The aim must be to provide patients receiving dental treatment with portable equipment the same range and standard of treatment that is available to patients receiving treatment in static dental surgeries.

The conclusion is that considerable effort is being made by dentists, dental manufacturers and dental organizations to improve portable dental equipment and facilities.

This thesis has attempted to show this effort and to display the current range of portable dental equipment and how it is used by various interested organizations.

The concept of this thesis has been to produce a survey of portable dental equipment. As can be seen, dramatic and exciting changes have taken place and will continue to take place in the field of portable dental equipment, as the profession fulfills its responsibilities to patients, who, through circumstances of geography, illness, being handicapped in one way or another, have the requirement that the dentist goes to the patient.

In the past, portable equipment has been the "orphan" of the dental equipment world. Modern use of technology has produced equipment that is the equal of any in use in static dental surgeries. Therefore, dependent on the aim of the dentist or agency supplying the service, any range of dental treatment can now be given in circumstances which in the past would have precluded or modified treatment.

With the modular arrangement of equipment any desired type of surgery can now be assembled.

The new acceptance of the need for portable equipment will generate further development, to the greater efficiency of the dentist and the increased comfort of the patient.

16. REFERENCES

1. Pickles, T.H. -
A review of the status of portable dental equipment.
J. of Pub.Health Dent., 29:1,p19, Winter 1969
2. Bremner, M.D.K.
The Story of Dentistry.
Dental Items of Interest Publishing Co., p.254,
2nd Col. 1946
3. Ewan, S.J. and Glickstein, C.
Ultrasonic Therapy in Periodontics.
Charles C.Thomas, Springfield, Ill., U.S.A
4. Editorial,
New Facilities.
Austral.Dent.J., 14:4, p.272-272 (Aug). 1969
5. Vinski, I.
The foot engine.
Brit.Dent.J., 130:3, p.125 (Feb.2nd) 1971.
6. Weerda, G.H.
Simplification of the dental working place.
Quintessence Int. 1:87-90 (May) 1970.
7. Barnard, P.D.
Facts and Figures - Australian Dentistry, 1971.
Published by Austral.Dent.Ass. 1971.
8. Commonwealth Bureau of Census and Statistics.
Census of population and housing 30 June 1971.
Field count statement No.2 - Population:
Principal urban centres of Australia. Ref.No.2.72
9. Winter, A.M.
Australia and beyond: a geography for fourth form.
Whitcombe and Tombs. 1968
10. Hoole, A.J. -
Dental services in institutions and government
departments in Australia.
Austral. Dent.Jour. Vol.8:1, p.36, (Feb). 1963
11. Collins, J.W. -
Programs of dental care for the aged and chronically ill.
Jour.Pub.Health Dent., 25:3, Summer, 1965.

12. Obst, J.J. -
Emergency problems in oral health care and clinical research in a chronic disease hospital.
J.Amer.Dent.Ass., 72:1130-7, (May), 1966.
13. Kimmel, K H. -
The classification of dental equipment.
Quintessence Inst., 1:107-8 (Feb), 1970.
14. Pic^Kles, T.H. -
A review of the status of portable dental equipment.
J. of Pub.Health Dent., 29:1, p.19, Winter, 1969.
15. Schmid, W. and Stevenson, S.B. -
Dynamic instrument placement and operator's and assistant's stool placement.
Dent.Clinics of North Amer., 15:1, p.145-148, (Jan), 1971.
16. Kimmel, K.E. -
Which chair for which functional purpose?
Quintessence Int., No.4, p.87-90 (April), 1970.
17. Weinert, A.M. -
An evaluation of the modern dental lounge chair.
Dent.Clinics of North Amer., 15:1, p.129-44 (Jan), 1971.
18. Tarsitano, J.J. -
Contour configuration.
J.Amer.Dent.Ass., Vol.70, p.1194-6, (May), 1965.
19. Anderson, J.A. -
Dental office design and layout.
J.Amer.Dent.Ass., Vol.60, p.344-353, (Mar), 1960
20. Schmid, W. And Stevenson, S.B.
Dynamic instrument placement and operator's and assistant's stool placement.
Dent.Clinics of North Amer., 15:1, p.149-155, (Jan), 1971.
21. Bahn, S.L.
Dental excellence requires keen vision.
Oral Health, 56:10, (Oct), 1966.
22. Miller, E.M. and Miller, J.S.
Oral lighting.
J.Amer.Dent.Ass., 71:4, p.856-865, (Oct), 1965.

23. Snow, W.D.
Dental operating lights.
The Royal Dental Hospital of Melbourne, (Unpublished)
(12 May) 1971.
24. Johns, R.B.
Integral fibro optic illumination for a handpiece.
Brit.Dent.Jour., Vol.129 (July-Dec), 1970.
25. Bomba, J.L.
Fibre optic lighting systems: Their role in dentistry.
Dent.Clin.of North Amer., 15:1, p.197-218 (Jan), 1971.
26. Thompson, W.R.
Principles of evacuation systems.
Dent.Clinics of North Amer., p.367, (July), 1967.
27. Davies, M.H., Rosen, M., Eccles, J.D., and Marshall, R.J.,-
Criteria of air flow and negative pressure for high
volume dental suction.
Brit.Dent.Jour., 130:11, (June), 1971.
28. Snedaker, R.F.
High volume evacuation.
Dent.Clin.of North Amer., Vol.15:1, p.157-168 (Jan),
1971.
29. McLundie, A.C., Kennedy, G.D.C., Stephen, K.W., and
Kennedy, T.F.-
Sterilization in general dental practice,
Brit.Dent.Jour., 124:5, p.214-8, (5 Mar), 1968.
30. Abel, L.C., Miller, R.L., Micik, R.E., and Ryge, G.-
Studies of dental aerobiology - 1V. Bacterial
contamination of water delivered by dental units.
Jour.of Dent.Research, 6:2, p.1567-69 (Nov-Dec), 1971.
31. Ewen, S.J. and Glickstein, C.
Ultrasonic therapy in periodontics.
Charles C.Thomas, Springfield, Ill., p.12, Chap.2.
32. Kilpatrick, H.C.
Auxiliary equipment for dental practitioners.
Dent.Clin.of North Amer., 15:1, p.188-191, (Jan), 1971.
33. Sockwell, C.L.
Dental handpieces and rotary cutting instruments.
Dent.Clin.of North Amer., 15:1, p.219-244 (Jan), 1971.

34. Mullen, J.H.
Principles of dental unit and rotary instrument design.
Dent.Clin.of North Amer., p.383-388, (July), 1967.
35. Oringer, M.J.
Electrosurgery in dentistry.
Philadelphia, W.B.Saunders Co., p.6, 1962.
36. Richards, A.G.
New concepts in dental X-Ray machines.
J.Amer.Dent.Ass., Vol.73, p.69-76, (July), 1966.
37. Holden, G.G.
Report on XV11 international dental exhibition held in Cologne from Aug.to Sept. 1968.
Dent.News.5:8-10 passim (Nov), 1968.
38. Young, W.O. and Striffler, D.F.
The dentist, his practice and his community.
W.B.Saunders Co., Philadelphia, p.236-263, end Ed., 1969.
39. Collins, J.W.
Programs of dental care for the aged and chronically ill.
J.of Pub.Health Dent., 25:3, p.116-119, Summer, 1965.
40. Walderman, H.B.
Increasing use of portable dental equipment.
J.of Pub.Health Dent., 25:3, p.120-121, Summer, 1965.
41. Mathewson, R.J. and Beaver, H.A.
A survey of dental care for handicapped children.
J.of Pub.Health Dent., 30:1, p.45-51, Winter, 1970.
42. Horowitz, H.S. and Hoag, O.S.
Study of the provision of dental care for handicapped children.
J.Amer.Dent.Ass., Vol.71, p.1397-410, (Dec), 1965.
43. Castaldi, C.R.
Dental health care programs for the handicapped child.
J.Amer.Dent.Ass., Vol.52, p.670-676, (June), 1956.
44. Lotzkar, S.
Dental care for the chronically ill, aged and homebound.
J.Amer.Dent.Ass., Vol.67, p.71-75, (July), 1963.

45. Silverman, S.I.
Dental care for the aged: role of the private practitioner.
J.Amer.Dent.Ass., Vol.64, p.165-172, (Feb), 1962.
46. Young, W.O. and Striffler, D F.
The dentist, his patient, and his community.
W.B.Saunders Co., Philadelphia. p.248, 2nd Ed., 1969.
47. Boller, R.J. and Posnick, I.H.
Fifteen years of hospital dentistry.
J.of Dent.for children, 34, p.56-64, (Jan), 1967.
48. Davey, K.-
Dental care in the Sioux lookout project.
J.Can.Dent.Ass.No.12, (Dec), 1971.
49. Kentwell, P.W.
The Royal Australian Army Dental Corps.in Vietnam.
Austral.Dent.Jour., 14:2, p.99-103, (Apr.), 1969.
50. Sharp, R.G.
R.A.A.F. air portable dental facilities.
Austral.Dent.Jour., Vol.15, p.16-18, (Feb.), 1970.
51. Docking, A.R.
Private correspondence, File No.3396/7
Commonwealth Bureau of Standards 14 July 1972.
52. Paffenbarger, G.C. and Ryge, G.
Report on the commission on dental materials,
instruments, equipment and therapeutics, 1968-69.
Int.Dent.Jour., 20:1, p.56-60; 1970.
53. Thompson, E.O.
Principles of efficient dental equipment use.
J.Amer.Dent.Ass., Vol.74, p.708-716, (Mar), 1967.
54. Editorial.
In the days of long ago.
Jour.of Dent.Ass.of South Africa, p.367, (15 Nov.), 1966.
55. Golden, S.S.
Human factors applied to study of dentist and patient
in dental environment - a static appraisal.
J.Amer.Dent.Ass., Vol.59, p.17-28 (July) 1959.

56. Thompson, E.O.
Principles of efficient dental equipment use.
J.Amer.Dent.Ass., Vol.74, p.708-716, (Mar), 1967.
57. Fox, J.G. and Jones, J.M.
Occupational stress in dental practice.
Brit.Dent.Jour., 123:10, (21 Nov), 1967.
58. Smith, J.W.
Ergonomics in the design of dental equipment.
Brit.Dent.Jour., 123:83-6, (18 July), 1967.
59. Hall, E T.
The hidden dimension.
Doubleday and Co.Inc., Chap.5, 1966.
60. Wall, C.
Private communication, DC70/42 (266)
Senior Dental Officer, Department of Health,
Darwin, 22 Aug., 1972.
61. Nixon, G.S.
Chairside Ergonomics.
Int.Dent.Jour. 21:2, p.270-275, (June), 1971.
62. Golden, S.S.
Human factors applied to study of dentist and
patient in dental environment - a static appraisal.
J.Amer. Dent.Ass., Vol.59, p.17-28, (July), 1959.
63. Kimmel, K.H.
Trends in dental working methods - training and
equipment in the limelight.
Quintessence Int., No.12, p.1,(Dec.), 1970.
64. Kilpatrick, H.C.
Present and future functional dental equipment - a
progress report.
J.Amer.Dent.Ass., 72:6, p.1348-1361, (June), 1966.
65. Green, E.J. & Brown, M.E.
Body mechanics applied to the practice of dentistry.
J.Amer.Dent.Ass., Vol.67, p.679-697, (Nov.), 1963.
66. Hebert, M.
Work simplification in dentistry.
Jour.Dent.Ass.of South Africa, 21:11, p.345, (Nov.),
1966.

67. Kilpatrick, H.C.

Present and future functional dental equipment -
a progress report.

J.Amer.Dent.Ass., 72:6, p.1348-1361, (June), 1966.

68. Editorial.

Care and maintenance of dental equipment Part 2.

Your surgery - a simple comprehensive service routine.

Dent.Mag. Oral Topics, 86:59-61, (Apr.), 1969.

69. Kilpatrick, H.C.

Present and future functional dental equipment - a
progress report.

J.Amer.Dent.Ass., 72:6, p.1348-1361, (June), 1966.

70. Kinersly, J.P. and Phatak, N.M.

Laser effects on tissue and materials related to
dentistry.

J.Amer.Dent.Ass., Vol.70, p.591 (Mar.), 1965.